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MODEL 1062
MODEL 1064

OSCILLOSCOPE
INSTRUCTION MANUAL

DUMONT
OSCILLOSCOPE

MODEL 1062
OSCILLOSCOPE

SERIALS PREFIXED 226

THIS MANUAL ALSO
APPLIES TO

MODEL 1064

DUMONT
OSCILLOSCOPE LABORATORIES, INC.

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NOTE

This manual is applicable to all 1062's whose serial number prefix is as indicated above. Any 1062's whose prefixes are different from the above have had changes which are covered by the appropriate addendums attached to the rear of this manual. The prefix of the last addendum should agree with the prefix of the 1062.

PART NO. 6704-9751

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1062 SPECIFICATIONS

VERTICAL DEFLECTION SYSTEM

Deflection Factor: 5 millivolts/division to 10 volts/division in 11 calibrated steps for each channel.
Deflection Accuracy: Within ± 3% of indicated deflection with VARIABLE control fully clockwise.
Variable Deflection Factor: Uncalibrated deflection factor at least 2.5 times the VOLTS/DIV switch indication. This provides a maximum uncalibrated deflection factor of 25 volts/division in the 10 volts position.
Frequency Response: (Measured with 25 ohms source impedance) (not more than 30% down)

5 mV to 10 V/DIV	DC to 60 MHz
Added (5 mV to 10 V/DIV)	DC to 60 MHz

Input Rc Characteristics: 1megohm ± 2%, paralleled by 25 pF ± 1 pF
Max Input Voltage: AC coupled 600 volts (DC + peak AC);
DC coupled 300 volts (DC + peak AC)
Input Coupling Modes: AC or DC, selected by front panel switch
AC Low Frequency Response: Typically 30% down at 4 Hz, AC GND DC switch set to AC
Vertical Display Modes: Channel 1 only
Channel 2 only
Dual Trace, alternate between channels
Dual Trace, chopped between channels
Added algebraically
Chopped Repetition Rate: Repetition rate of approximately 500 KHz
Common Mode Rejection Ratio: Greater than 20:1 at 2 MHz, input signal less than ten times VOLTS/DIV
Position Range: Approximately three screen diameters
Polarity Inversion: Signal on Channel 1 or Channel 2 can be inverted
Vertical Drift: At 5 mV, not more than 1 mV over five hour period; after 15 minutes warm-up

TRIGGERING (Main and Delayed Sweep)

Source: Internal from displayed channel or from Channel 1
External
External divide by 10
Internal from AC line
Coupling: AC
AC low frequency reject
AC high frequency reject
DC
Mode: Channel 1 only, Channel 2 only or display
Slope: Sweep can be triggered from positive-going or negative-going portion of trigger signal
Internal Trigger Sensitivity:

AC	0.5 div of deflection, minimum, 4 Hz to 50 MHz
LF REJ	0.5 div of deflection, minimum, 30 KHz to 50 MHz
HF REJ	0.5 div of deflection, minimum, 4 Hz to 50 KHz
DC	0.5 div of deflection, minimum, DC to 50 MHz

External Trigger Sensitivity:

AC	50 millivolts, peak-to-peak, minimum, 4 Hz to 60 MHz
LF REJ	50 millivolts, peak-to-peak, minimum, 30 KHz to 60 MHz
HF REJ	50 millivolts, peak-to-peak, minimum, 4 Hz to 50 KHz
DC	50 millivolts, peak-to-peak, minimum, DC to 60 MHz

Auto Triggering: (Main Sweep Only) Provides normal triggering above approximately 20 Hz and produces free-running sweep in absence of trigger signal
Single Sweep: Triggering capability same as normal trigger
Display Jitter: Less than 1 nanosecond at 10 nanoseconds/DIV
Maximum Input Voltage: 300 volts (DC + peak AC) X1 positions: 600 volts (DC + peak AC) in EXT/10 position
External Trigger
Input Rc Characteristics: Approximately 1 megohm paralleled by 30 pF
Level Control Range: ± 1.5 volts, EXT 1X
± 15 volts, EXT ÷ 10

HORIZONTAL DEFLECTION SYSTEM (Main and Delayed Generator)

Sweep Rates:

Main	0.1 microsecond/division to 1 second/division in 22 calibrated steps
Delayed	0.1 microsecond/division to 1 second/division in 22 calibrated steps

Sweep Accuracy:
1 SEC/DIV to 0.1 SEC/DIV – Within ± 3% of indicated sweep rate
Variable Sweep Rate: Uncalibrated sweep rate to 2.5 times the TIME/DIV indication

SWEEP MAGNIFIER

Sweep Magnification: Each sweep rate can be increased 10 times the indicated sweep rate by horizontally expanding the center division of display (fastest sweep 10 ns/cm)
Magnified Sweep Accuracy: ± 2% tolerance added to specified sweep accuracy

SWEEP DELAY

Calibrated Delay Time Range: Continuous from 10 seconds to 0.1 microseconds
Incremental Delay Accuracy: ± 0.3%
Delay Time Jitter: Less than 1 part in 20,000 of 10 times main TIME/DIV switch setting

EXTERNAL HORIZONTAL AMPLIFIER

Input: EXT horizontal connector
Deflection Factor: Unmagnified – X1 Horizontal Gain
Variable 120 mV/cm to 1.2 V/cm
X10 Horizontal Gain
Variable 12 mV/cm to 120 mV/cm
÷ 10 External Horizontal
Variable 1.2 V/cm to 12 V/cm
Frequency Response: DC to 4 MHz, not more than 30% down, trig coupling in DC position
Input Rc Characteristics: Approximately 1 megohm, paralleled by 30 pF

CALIBRATOR

Waveshape: Square wave, duty cycle 50% ± 5%
Polarity: Positive-going with baseline at zero volts.
Output Voltage: [redacted] peak-to-peak ± 1% 1 V and 0.3 V
Repetition Rate: 1 KHz, approximately
Rise Time: Less than 1 microsecond

Z AXIS INPUT

Sensitivity: 2 volts peak-to-peak signal produces noticeable intensity modulation
Rise Time: 70 ns
Input Resistance: Approximately 5 K ohms
Input Coupling: DC coupled
Polarity of Operation: + input decreases intensity
Maximum Input Voltage: 20 V combined (DC + peak AC)

POWER SUPPLY

Voltage Requirements:

115 Volt Range	105 to 125 V
230 Volt Range	209 to 255 V

Line Frequency: 48 to 400 Hz
Power Consumption: 75 watts maximum

CATHODE-RAY TUBE (CRT)

Phosphor: P31 standard; others available on special order
Accelerating Potential: 12 kV
Graticule Type: Internal
Area: 8 cm vertical by 10 cm horizontal
Illumination: Variable edge lighting

MECHANICAL CHARACTERISTICS

Overall Dimensions:
(measured at max. points) 8¼" x 11½" x 21-7/32" without cover
Net Weight: 30 lbs. approximately
Temperature:

Operating	0°C to + 55°C
Non-Operating	–20°C to + 75°C

General Information

1-1. DESCRIPTION

1-1a. The model 1062 is a high frequency, high performance, portable oscilloscope. It is suited for use in design, testing, and service of high frequency, analog, or digital circuits. Its 5.8 ns rise time allows the viewing of very fast phenomena. A unique trigger system allows a vertical display in the alternate mode with composite triggering, such that separation of the traces produces no trace flicker due to loss of synchronism.

1-1b. The model 1062 features all solid state circuit design (except for the CRT) including FET input amplifiers and micro logic vertical mode switching.

1-1c. The vertical channels with 60 MHz bandwidth capability can be viewed individually or together in an alternate or chopped mode as well as an added mode. Trigger selection allows composite, channel 1, or channel 2 only triggering.

1-1d. The horizontal section features a main and a delayed sweep as well as an external 4 MHz horizontal port. With the X10 horizontal expansion, a sweep time of 10 ns per cm is achievable.

1-1e. External intensity modulation is available through a rear panel connector and has a rise time of approximately 70 ns.

1-1f. An internal 1 KHz square wave generator with output levels of 60 mv and 600 mv is available for scope and probe calibration.

1-2. CATHODE-RAY TUBE

1-2a. The CRT features an internal 8 x 10 cm graticule to eliminate parallax problems. An accelerating potential of 12 kV provides a very high writing rate for viewing low duty cycle signals.

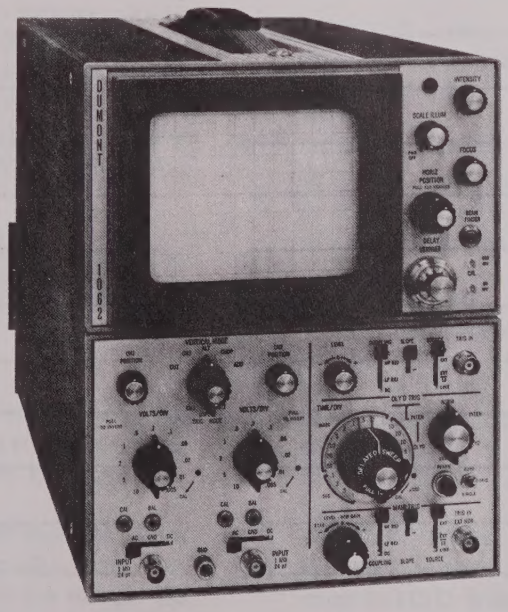


Figure 1-1. Model 1062

Notes

Section 2

Operation

2-1. INITIAL INSPECTION

2-1a. Check instrument for any damage due to shipping immediately after receipt. Check for dents or broken parts and for scratched surfaces.

2-1b. Electrical check is outlined in Section 4.

2-2. CLAIMS

2-2a. If any physical damage or electrical specification problems occur in the initial inspection as outlined above, notify the nearest DUMONT Sales/Service office immediately.

2-3. REPACKAGING FOR SHIPMENT

It is mandatory that when shipping an instrument to any Dumont sales/service office, the original packing materials or equivalent be used to re-package the instrument. Equivalent packing includes (1) a double-walled, heavy duty corrugated cardboard container (2) soft paper surrounding the instrument to protect it from minor abrasions (3) some type of shock-absorbing material to surround the instrument.

It is also important to very clearly indicate on a tag attached to instrument, what the failure mechanism is.

2-4. PREPARATION FOR USE

2-4a. The model 1062 will operate on 115 Volt AC or 230 Volt AC ± 10%, single phase, 50 to 400 Hz power source. The power source must be able to supply 100 Watts.

2-4b. BEFORE CONNECTING THE INSTRUMENT TO A POWER SOURCE, check that the 115/230 V AC slide switch (52) is set to the correct nominal line voltage. The instrument comes equipped with a 2 aSB fuse for 115 Volt AC operation. If the nominal line voltage is 230 Volt AC, replace the 2 aSB fuse with a 1 aSB fuse.

2-4c. The model 1062 oscilloscope is convection cooled. It is important, therefore, that nothing disturb the air circulation when operated in an ambient environment 0 to 55°C.

2-5. EXTERNAL CONTROLS

NOTE: *Throughout this manual references to the external controls will appear in capital letters followed by the reference number listed in Paragraphs 2-5a. and 2-5b.*

2-5a. Front Panel (refer to Fig. 2-1)

1. CH1 IN – Input Connector for CH1.
3. CALIBRATE – Adjust CH1 gain for calibration.
4. BALANCE – Adjust CH1 DC balance.
5. AC-GND-DC – Selects input coupling mode to CH1.
6. VOLTS/DIVISION – Sets CH1 sensitivity.
7. VERNIER – When rotated provides continuous gain control of CH1. When pulled, inverts CH1 signal.
8. CH1 POSITION – Adjusts vertical position of the CH1 trace.
9. VERTICAL MODE – Selects vertical mode.
   a. CH1 – Selects CH1 only.
   b. CH2 – Selects CH2 only.
   c. CHOP – Selects CH1 and CH2 alternately at a 500 KHz rate.
   d. ALTERNATE – Selects CH1 and CH2 alternately, alternating with each sweep.
   e. ADD – Adds CH1 and CH2 together.
10. TRIGGER MODE – Selects triggering from CH1 ONLY CH2 ONLY or from both CH1 and CH2 in the DISPLAY mode.
11. CH2 POSITION – Adjusts vertical position of CH2 trace.
12. VOLTS/DIVISION – Sets CH2 sensitivity.
13. VERNIER – When rotated provides continuous gain control of CH2. When pulled, inverts CH2 signal.
14. AC-GND-DC – Selects input coupling mode to CH2.
16. CALIBRATE – Adjusts CH2 gain.
17. BALANCE – Adjusts CH2 DC balance.

18. CH2 IN — Input connector for CH2.
19. LEVEL/HORIZONTAL GAIN — with horizontal mode (29) not in EXTERNAL HORIZONTAL mode, controls the trigger level of the main sweep trigger. With HORIZONTAL MODE (29) in EXTERNAL HORIZONTAL mode, provides continuous control of horizontal amplifier gain.
20. STABILITY — Provides Vernier adjustment of hold-off time to improve high frequency synchronization.
21. COUPLING — Determines coupling mode to trigger input circuits except when HORIZONTAL MODE (29) is in the EXTERNAL HORIZONTAL position. In EXTERNAL HORIZONTAL it determines the coupling mode to the horizontal amplifier.
    a. DC — DC couples input.
    b. HIGH FREQUENCY REJECT — Rejects high frequencies (above 30 KHz).
    c. LOW FREQUENCY REJECT — Rejects low frequencies (below 50 KHz).
    d. AC — AC Couples input.
22. SLOPE — Selects on which slope, + or —, the main sweep triggers.
23. SOURCE — Selects trigger source when HORIZONTAL MODE (29) not in EXTERNAL HORIZONTAL mode. When HORIZONTAL MODE (29) in EXTERNAL HORIZONTAL, selects either an external signal or the line signal for horizontal deflection.
    a. INTERNAL — Internal signal from CH1 and/or CH2 pre-amplifier.
    b. EXTERNAL — External signal from TRIGGER-IN (24) jack.
    c. EXTERNAL/10 — Attenuates external input signal by 10.
    d. LINE — Signal from power line for line sweeping or line synchronizing.
24. TRIGGER-IN/EXTERNAL HORIZONTAL — Input for an external signal to be used for triggering or for horizontal deflection depending on position of HORIZONTAL MODE (29) control.
25. SWEEP MODE
    a. AUTO — Allows main sweep to free-run or to be triggered from an input whose repetition rate is greater than 20 Hz.
    b. TRIGGER — Sweep will be triggered only if a signal is present.
    c. SINGLE — Allows only one triggered sweep to occur when sweep circuit is armed by REARM (26) control.
26. REARM — Indicates condition of main sweep. When lit, main sweep ready for triggering. Used mostly in conjunction with SINGLE sweep function of SWEEP MODE (25) control.

27A. MAIN SWEEP TIME — Indicates horizontal calibration in time/div of main sweep with vernier in CAL position.

27B. DELAYED SWEEP TIME — Indicates horizontal calibration of delayed sweep in time/div with vernier in CAL position.

28. VERNIER — Provides continuous adjustment of TIME/div (27A) when HORIZONTAL MODE (29) is in NORM, and continuous adjustment of Time/div (27B) when HORIZONTAL MODE (29) is in INTEN or DELAYED.
29. HORIZONTAL MODE — Selects the mode in which the horizontal section operates.
    a. NORMAL — This mode allows only the main sweep to function.
    b. INTENSIFIED — This allows the main sweep to have an intensified area, the start and duration of which are controlled by the DELAY VERNIER (35) and DELAYED SWEEP TIME (27B) controls respectively. Delayed sweep triggering in this mode is automatic.
    c. DELAYED — The entire horizontal trace is the intensified area referred to in b above.
    d. DELAYED TRIGGERED INTENSIFIED — Same as b above, except that in this case the DELAY VERNIER (35) arms the delayed sweep. The delayed sweep is triggered depending upon the delayed trigger controls (30, 3l, 32, 33, 34).
    e. DELAYED TRIGGER DELAYED — The entire horizontal trace is the intensified area referred to in d above.
    f. EXTERNAL HORIZONTAL — Disables all trigger and sweep functions and sets up the horizontal amplifier for external signals depending on controls (19, 21, 23, 24).
30. TRIGGER-IN — Input for externally triggering delayed sweep.
31. SOURCE — Selects delayed sweep trigger source.
    a. INTERNAL — Uses internal signals from vertical pre-amplifiers for triggering.
    b. EXTERNAL — Uses signals from TRIGGER-IN (30) for triggering.
    c. EXTERNAL/10 — Divides external input signals by 10.
    d. LINE — Selects the power line signal for triggering.
32. SLOPE — Selects on which slope, + or —, the delay sweep triggers.
33. COUPLING — Determines coupling mode to delay trigger input circuits, in a manner similar to COUPLING (2l) control.
34. LEVEL — Selects level at which delayed triggering occurs.
35. DELAYED VERNIER — Establishes the time at which the delayed sweep starts when the HORIZONTAL MODE (29) control is in the INTENSIFIED or DELAYED position, and the time at which the delayed sweep is armed for triggering when the HORIZONTAL MODE (29) control is in the DELAYED TRIGGER INTENSIFIED or DELAYED TRIGGER DELAYED position.

36. HORIZONTAL POSITION — Provides coarse control of horizontal position of the trace.
37. VERNIER/X10 — When rotated provides vernier control of the horizontal position. When pulled provides an increase in horizontal gain of 10 times.
38. FOCUS — Focuses trace.
39. INTENSITY — Provides continuous intensity control of trace.
40. SCALE ILLUMINATION/ON-OFF — Applies power to instrument and provides variable intensity to graticule.
41. BEAM FINDER — Overrides intensity, vertical position and horizontal position, and restricts beam position to lie within the graticule.
42. CALIBRATOR 600 mv — 1 KHz square wave, 600 mv, p-p.
43. CALIBRATOR 60 mv — 1 KHz square wave, 60 mv, p-p.

2-5b. Rear Panel (refer to fig. 2-2)

45. Z INPUT — For use in externally controlling intensity of the trace.
46. INTENSITY LIMIT — Adjusts maximum trace intensity.
47. ASTIGMATISM ADJUST — Adjusts astigmatism of CRT spot.
48. PATTERN ADJUST — Adjusts CRT pattern to be rectangular.
49. TRACE ALIGNMENT — Aligns CRT trace to the graticule.
50. MAIN SWEEP LENGTH —
    a. Full — Main sweep ends itself.
    b. Delayed ends main — Delayed sweep ends main sweep.
51. LINE FUSE.
52. 115/230 — Selects nominal line voltage.
53. LINE INPUT CONNECTOR.

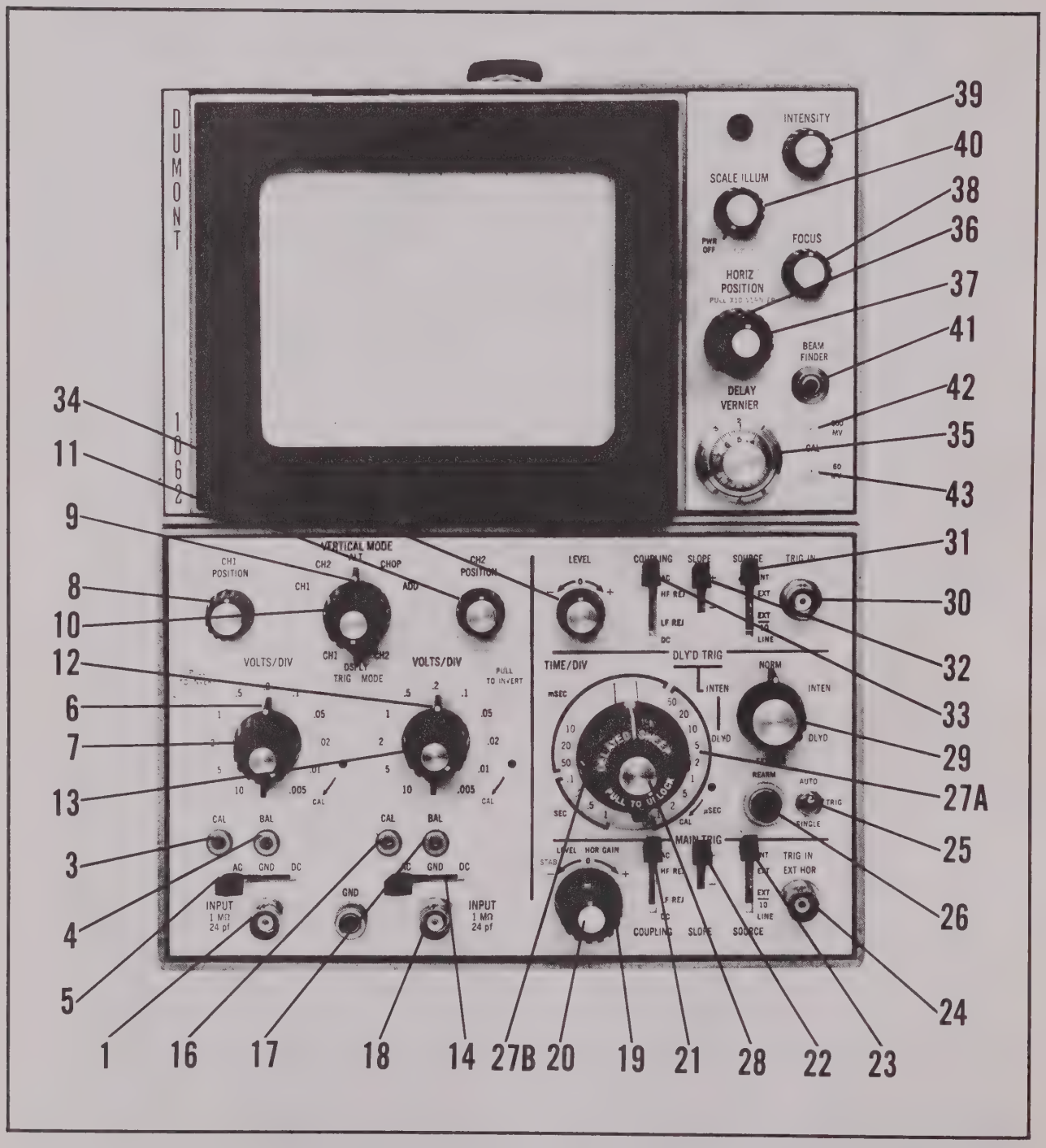


Figure 2-1. 1062 Front Panel Controls

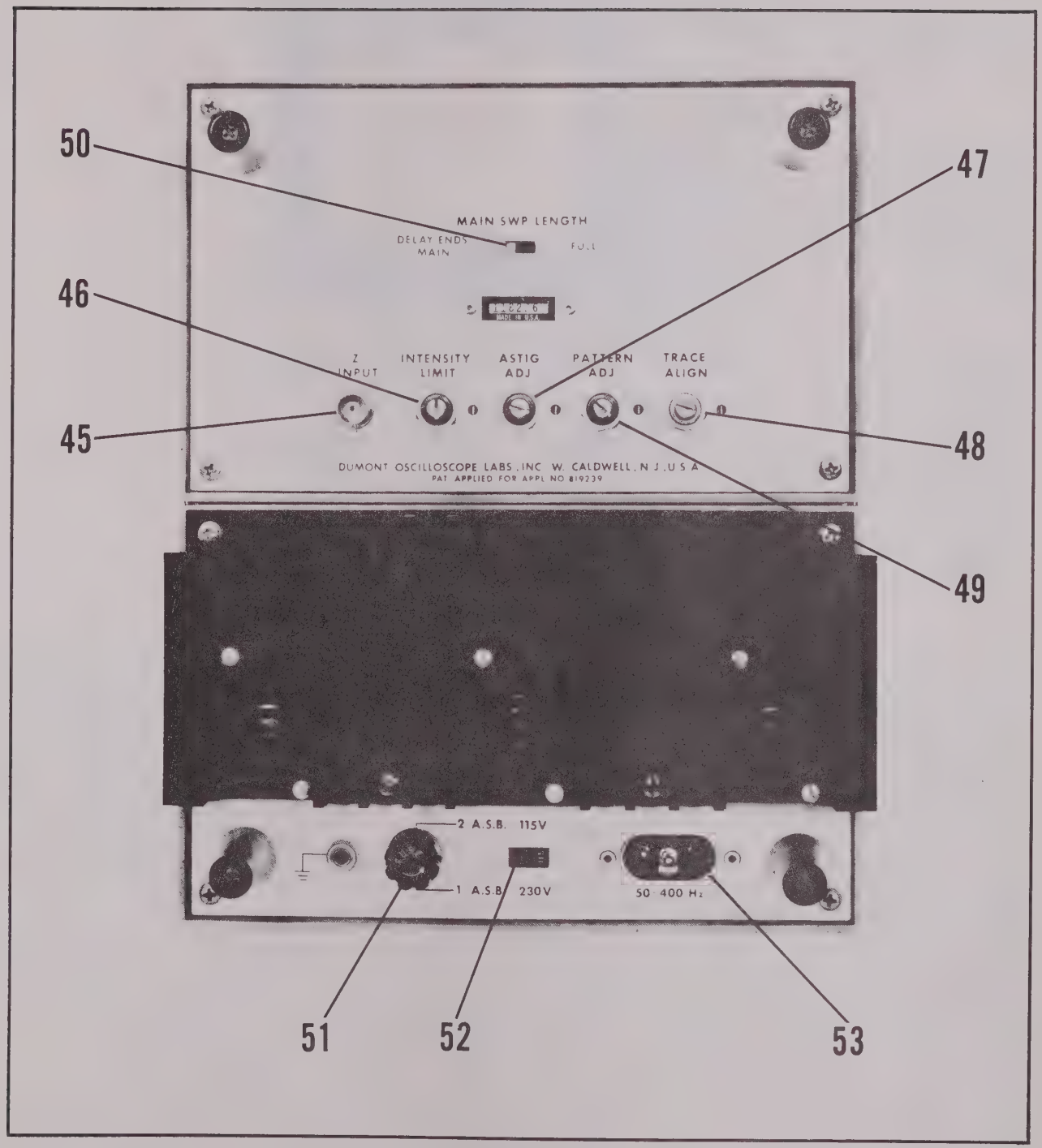


Figure 2-2. 1062 Rear Panel Controls

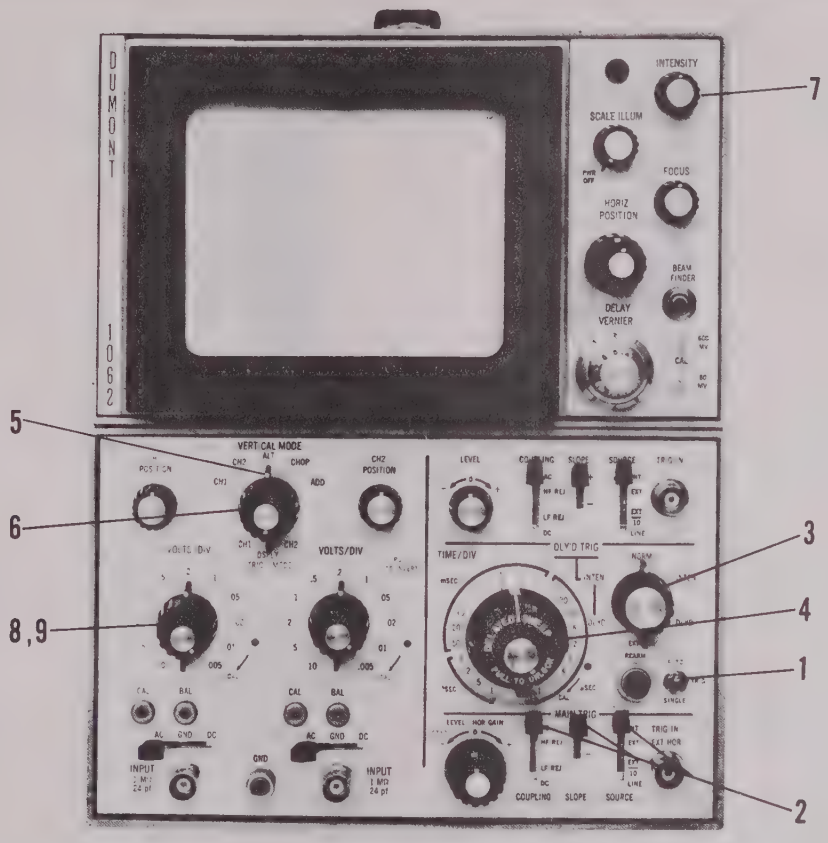
2-6. TYPICAL SET-UP PROCEDURE

2-6a. Figures 2-3 through 2-6 describe the steps necessary to initiate typical modes of operation available with the model 1062 oscilloscope.

CAUTION

Before connecting any signals to the 1062 it is necessary to observe the limitations of 300 Volts peak for the CH1 (1), CH2 (18), TRIGGER-IN (24), and TRIGGER-IN (30) connectors. Also a maximum of 20 Volts peak on the Z INPUT (45).

1. Connect signals to CH1 (1) and/or CH2 (18) connectors.
2. Figures 2-3 through 2-6 describe various modes of operation, however, all use internal triggering only. Trigger modes other than internal can be utilized by connecting the trigger source to either TRIGGER-IN (24), or TRIGGER-IN (30) connectors, depending upon whether the main or delayed sweep is to be triggered. Refer to section 2, paragraph 2-5, for a description of the trigger controls.



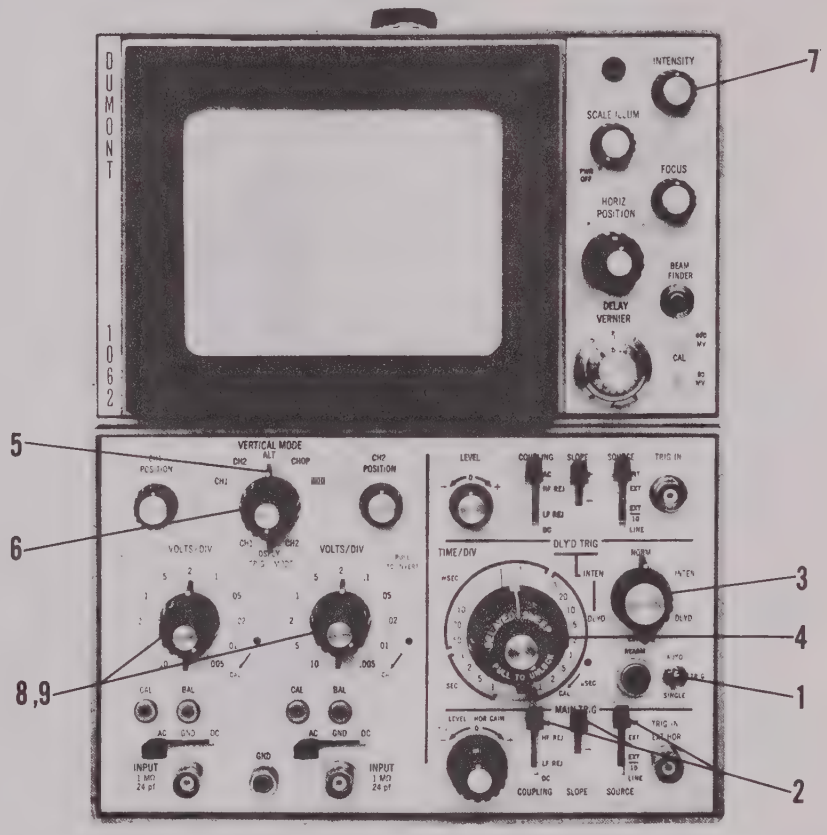
Set front panel controls to:

1. SWEEP MODE (25) – AUTO.
2. All lever switches in main trigger section – up.
3. HORIZONTAL MODE (29) – NORMAL.
4. VERNIER (28) – CAL.
5. VERTICAL MODE (9) – CH1.
6. TRIGGER MODE (10) – DSPLY.
7. INTENSITY (39) – ¾ full on.
8. GAIN VERNIER (7) – CAL.

At this time a trace should be on the screen. If not, depress BEAM FINDER (41) and adjust CH1 POSITION (8) and HORIZONTAL POSITION (36) to center the trace. Release BEAM FINDER (41) and adjust INTENSITY (39) to desired brightness. With signal connected to CH1 (1), adjust AC-GND-DC (5) VOLTS/DIVISION (6), CH1 POSITION (8), LEVEL (19), and TIME/DIVISION (27A) to give the desired display.

To utilize CH2 connect signal to CH2 (18) and repeat the above for CH2 controls, and place VERTICAL MODE (10) to CH2.

Figure 2-3. Normal Sweep Single Channel Operation



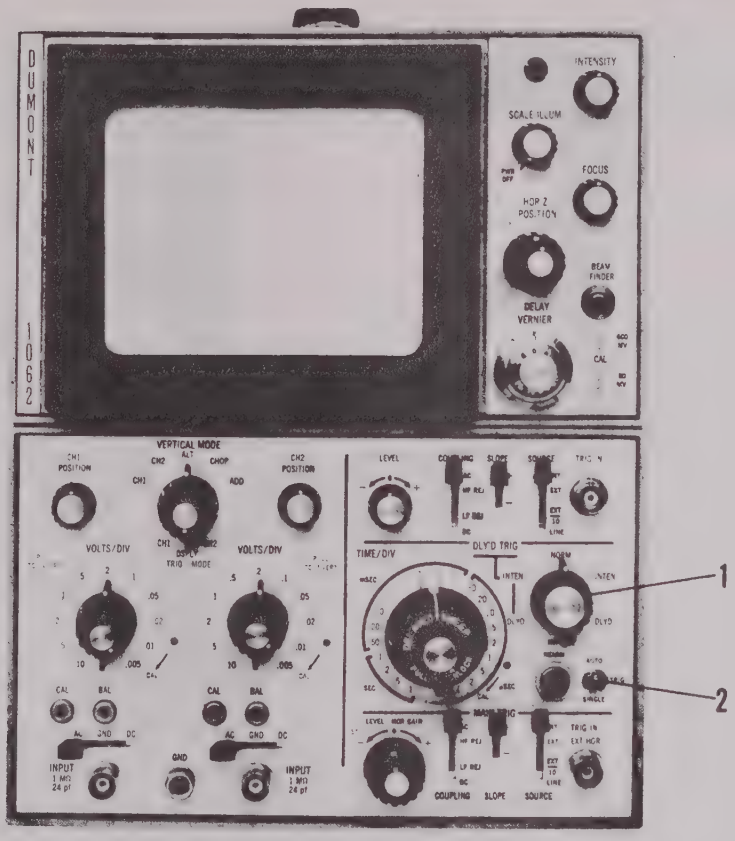
Set front panel controls to:

1. SWEEP MODE (25) – AUTO.
2. All switches in main trigger section – up.
3. HORIZONTAL MODE (29) – NORMAL.
4. VERNIER (28) – CAL.
5. VERTICAL MODE (9) – CH1.
6. TRIGGER MODE (10) – DSPLY.
7. INTENSITY (39) – ¾ full on.
8. GAIN VERNIER (7 & 13) – CAL.

At this time a trace should be on the screen, If not, depress BEAM FINDER (41) and adjust CH1 POSITION (8) and HORIZONTAL POSITION (36) to center the trace. Release BEAM FINDER (41) and adjust INTENSITY (39) to desired brightness. The two methods of dual channel operation possible are chopped and alternate. In the alternate mode, the sweep alternates with each trace between CH1 and CH2. In this mode there is an option to trigger the sweep from CH1 only CH2 only or from CH1 when viewing CH1, and from CH2 when viewing CH2. To obtain this mode set VERTICAL MODE (9) to ALTERNATE and TRIGGER MODE (10) to CH1 or COMPOSITE as desired.

In the chopped mode a 500 KHz signal switches between CH1 and CH2. In this mode it is necessary to trigger from CH1 only or CH2 only, and this mode is obtained by setting the VERTICAL MODE (9) to CHOPPED and TRIGGER MODE (10) to CH1 or CH2. In either of the above modes, adjust the AC-GND-DC (5 & 14), VOLTS/DIVISION (6 & 12), CH1 POSITION (8), CH2 POSITION (11), LEVEL (19), and TIME/DIVISION (27A) to give the desired display.

Figure 2-4. Normal Sweep Dual Channel Operation



Refer to Figures 2-3 and 2-4 for vertical display, information and settings.

The two modes of delayed sweep possible are non-triggered and triggered delayed sweep. The non-triggered delayed sweep is initiated by setting:

1. HORIZONTAL MODE (29) – INTENSIFIED.
2. SWEEP MODE (25) – AUTO.

The display at this time should be a trace of normal intensity for the first part of the trace followed by an intensified portion. The length of the intensified portion is controlled by the TIME/DIVISION (27B) switch, and the start of it is controlled by the DELAY VERNIER (35) control. Setting the HORIZONTAL Mode (29) to the DELAYED Position causes the intensified portion of the trace to be displayed as the full trace. The sequence below shows this.

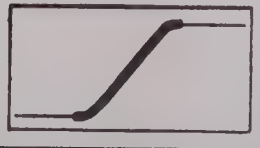
The triggered delayed sweep is similar to the non-triggered mode with the exception that the DELAY VERNIER (35) arms the delayed sweep for triggering, the triggering being set by the SOURCE (31), SLOPE (32), COUPLING (33), LEVEL (34), and TRIGGER-IN (30) controls. The triggered intensified delayed sweep mode is obtained by setting:

1. HORIZONTAL MODE (29) – DELAYED TRIGGER INTENSIFIED.
2. SWEEP MODE (25) – AUTO.

The triggered delayed mode is obtained by setting:

1. HORIZONTAL MODE (29) – DELAYED TRIGGERED DELAYED.
2. SWEEP MODE (25) – AUTO.

INTEN



DLYD

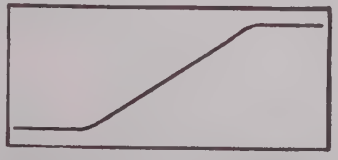
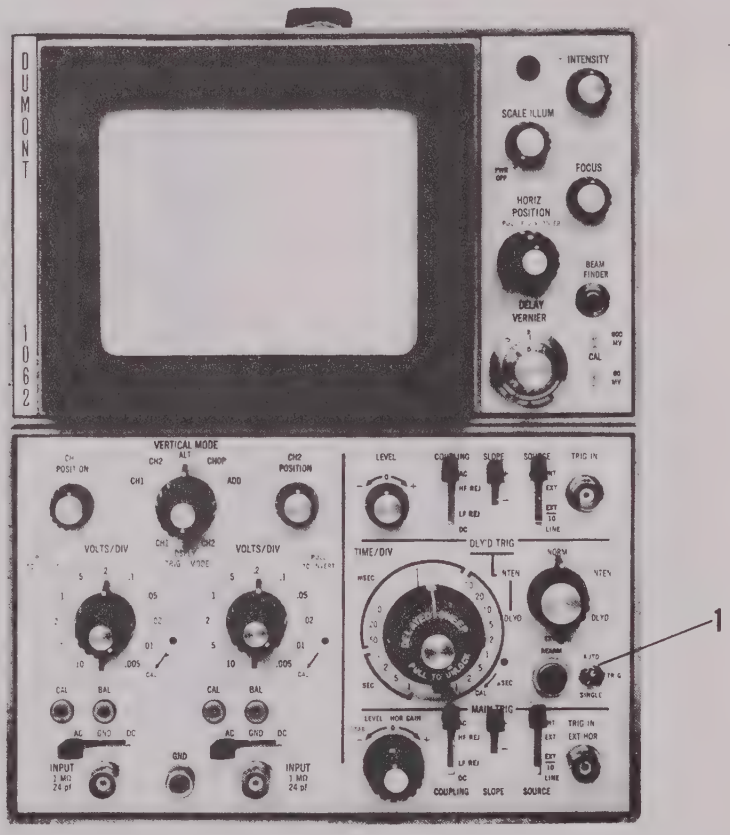


Figure 2-5. Single or Dual Channel Delayed Sweep Operation



Refer to Figures 2-3 and 2-4 for vertical display, information and setting.

The single sweep mode allows the sweep to be triggered once by the trigger signal. It is initiated by setting:

1. SWEEP MODE (25) – SINGLE.

   With no trigger signal present, depress REARM (26) control. The sweep is now armed for triggering. A trigger from any source, internal, external, or line will cause one sweep to occur.

Figure 2-6. Single Sweep Operation

Principles of Operation

3-1. INTRODUCTION

3-1a. The model 1062 oscilloscope covers the frequency range from DC to 60 MHz with a sensitivity of 5 mv per cm. There are two vertical channels as described above, with vertical modes; CH1, CH2, ALTERNATE, CHOPPED, or ADDED. The horizontal time-base can be set to 100 ns per cm, or by utilizing the X10 horizontal expand, a time-base of 10 ns per cm can be achieved. In addition to the main sweep a delayed sweep mode is also available.

The trigger modes are CH1, CH2, or COMPOSITE, where composite results in triggering from the channel being displayed.

The 1062 can also be used as an X, Y scope, the horizontal channel having a bandwidth of 4 MHz. DC coupled Z axis modulation allows low or high frequency markers to be inserted. An internal 1 KHz calibrator makes for easy scope and probe calibration.

3-2. OVERALL DESCRIPTION

3-2a. Refer to Figure 5-1. The signal/s being viewed are connected to the input connectors, marked CH1 or CH2. After going through a step attenuator which gives course adjustment in calibrated steps to the vertical sensitivity, the signals go through wide band preamplifiers to the vertical modulator at which point channel selection is made through the VERTICAL MODE (9) control. The output of the vertical modulator drives through the delay line to the vertical output amplifier, which, subsequently, deflects the beam vertically in the CRT.

3-2b. Samples of the CH1 and CH2 signals are picked off prior to the CH1, CH2 POSITION controls and sent to a trigger modulator which is followed by a trigger preamplifier. The trigger modulator is controlled by both the TRIGGER MODE (10) and VERTICAL MODE (9) controls.

The trigger preamplifier delivers signals to both the main and delayed sweep trigger circuits. In the main sweep trigger circuit, this signal goes to a comparator which subsequently generates the main sweep trigger pulse. The COUPLING (21), SLOPE (22), SOURCE (23), LEVEL (19) & HORIZONTAL MODE (29) controls affect the operation of this main sweep trigger generator. The delayed sweep trigger circuit functions in a similar manner except that the controls affected are SOURCE (31), SLOPE (32), COUPLING (33), LEVEL (34) & HORIZONTAL MODE (29) instead.

3-2c. With the HORIZONTAL MODE (29) control in NORMAL and the SWEEP MODE control in either AUTO or TRIGGER, the output of the main sweep trigger generator triggers the main sweep generator. The output of the main sweep generator drives the horizontal output amplifier, which subsequently deflects the beam of the CRT horizontally. Another output of the main sweep generator goes to the Z axis amplifier to blank the display on re-trace.

3-2d. The two modes of delayed sweep are triggered and non-triggered, and are controlled by the HORIZONTAL MODE (29) control. Consider first the non-triggered delayed sweep.

In this mode the main sweep ramp is compared to a voltage level as determined by the DELAY VERNIER (35) control. When the main sweep ramp reaches a level-pre-determined by the DELAY VERNIER (35) control, the delayed sweep ramp generator is triggered, the duration of which is controlled by the DELAYED SWEEP (27B) time base control. When the HORIZONTAL MODE (29) control is in the INTENSIFIED position, a gate is generated which intensifies the display during the period in which the delayed sweep ramp generator is operating. This intensified region is displayed on the entire screen of the CRT when the HORIZONTAL MODE (29) control is placed in the DELAYED position. The triggered delay sweep is similar to the above with the exception that, when the main sweep ramp is compared to the DELAY VERNIER (35) voltage, the delayed sweep ramp generator is armed for triggering but does not sweep until a trigger appears. This mode of operation is initiated by placing the HORIZONTAL MODE (29) control in the DELAYED TRIGGERED INTENSIFIED and DELAYED TRIGGERED DELAYED positions.

3-2e. A further mode of operation, X, Y, is initiated by placing the HORIZONTAL MODE (29) control to EXTERNAL HORIZONTAL. In this mode, a signal, connected to the EXTERNAL HORIZONTAL (24) port or a sample of the line voltage, is fed directly to the horizontal input amplifier, and subsequently, to the horizontal deflection plates of the CRT.

3-3. VERTICAL AND TRIGGER MODE LOGIC

3-3a. The outputs of the CH1 and CH2 preamplifiers each pass through a diode gate to a common point which goes to the vertical output amplifier through the delay line. The condition of these gates is determined by the vertical mode logic circuitry. When the VERTICAL MODE (9) control is set CH1 or CH2 only, the appropriate diode gate is open allowing the selected channels to be displayed.

In the CHOPPED mode the vertical mode logic circuits form a 500 KHz oscillator which then alternately open and close the vertical gates at this 500 KHz rate.

In the ADDED mode both gates are open allowing the CH1 and CH2 signals to be added algebraically. When the VERTICAL MODE (9) control is positioned to the ALTERNATE mode, an alternate sync signal from the main sweep generator controls the vertical mode logic circuits, causing CH1 to be displayed for one entire sweep and then CH2 to be displayed for the next sweep, alternating back and forth.

3-3b. The trigger modes available are CH1, CH2 and COMPOSITE. The trigger gates which accept samples of the CH1 and CH2 signals, are similar to the vertical gates described in paragraph 3-3a. When the TRIGGER MODE (10) control is set to CH1, the CH1 gate is open, making available only the CH1 signal for sweep synchronziation. When it is desired to trigger from the signal being displayed (for example, in the alternate mode of operation) the composite trigger mode can be used. In this case the vertical mode logic circuitry controls the trigger gates, thus, when CH1 is being displayed, the sweep is synchronized to CH1 and when CH2 is being displayed, the sweep is synchronized to CH2.

3-4. DETAILED THEORY OF OPERATION

3-4a. When reading this section, fold out the schematic in Section 5 which applies. The figure number is noted next to the title of the section. The main signal paths to be followed are represented by the bold solid lines appearing on the schematic, and any feedback paths are indicated by the bold dashed lines.

3-5. VERTICAL ATTENUATOR AND INPUT BUFFER (Figure 5-2)

3-5a. The signal path shown in Figure 5-2 is the unattenuated path and represents the most sensitive one. This attenuator operates on a 1, 2, 5 sequence by employing a ÷ 2 and ÷ 4 section and a ÷ 10, ÷ 100 and ÷ 1000 section. Each section has separate adjustments for both high frequency compensation and input capacitance.

3-5b. After the attenuator, the signal reaches the input buffer amplifier A4A9Q1. This amplifier is a dual FET used as a source follower. It exhibits excellent temperature characteristics and provides a low source impedance to drive the vertical preamplifier A10. It is protected from input signal overloads by A4A9CR1 and A4A9CR2 and A4A9R19.

3-5c. DC balance is provided for in the input buffer amplifier by adjusting A4A9R1.

3-6. VERTICAL PREAMPLIFIER (Figure 5-3)

3-6a. The single-ended signal from the CH1 vertical attenuator is fed to A10Q1 which acts as an emitter follower to drive A10Q2. A10CR17 and A10CR18 conduct in the presence of large signals and thus control the overload characteristics of the vertical amplifier chain. This prevents overload signals from returning on-screen.

3-6b. The differential cascode amplifier, consisting of A10Q2, and A10IC1 transforms the single-ended input signal into a differential signal. In order to insure a differential signal at very high frequencies, a balum, A10T1, is used. The collector load of A10IC1 determined by A10R23, A10R21 and A10R22. This collector load in combination with the emitter load of A10Q2 (A10R8 plus A10R9) determines the gain of the cascode amplifier. A10C3 determines the high frequency peaking of this amplifier. In order to accommodate CRT's of low sensitivity, a test option is available through A10R11. When the sensitivity is low, A10R11 is required.

3-6c. A10Q6 and A10Q7 are used as emitter followers to drive A10Q8 and A10Q9 respectively. They are also used to drive trigger amplifier A10Q12 and A10Q13 through A10R29 and A10R30.

3-6d. Diode matrix A10CR1,2,3,4 and A10CR5,6,7,8 are used as switches and determine the vertical mode. They are controlled by the vertical mode logic gates from the logic circuits.

When CH1 is called for, by setting the VERT MODE (9) to CH1, A10CR1, A10CR4, A10CR6 and A10CR7 are forward biased and A10CR2, A20CR3, A10CR5 and A10CR8 are reverse biased. This disconnects Channel 2 and forms a differential cascode amplifier between A10Q8, A10Q9, A10Q10 and A10Q11 which drives the vertical output amplifier (A8) through the 120 nsec delay line.

3-6e. At this time, it is important to note that the operation of Channel 2 is identical to that of Channel 1. Consequently, use the discussion in Paragraphs 3-6a through 3-6d to determine the theory of operation.

3-6f. A10Q12 and A10Q13 form a differential amplifier which amplifies the trigger pick-off signal from Channel 1. A10Q23 and A10Q24 form an equivalent amplifier for the Channel 2 trigger pick-off signal. The diode matrices A10CR9,10,11,12 and A10CR13,14,15,16 operate in a similar manner to that described for the vertical switches in Paragraph 3-6d. Here, however, the TRIGGER MODE (10) determines the condition of these switches as follows: When the TRIGGER MODE (10) is in Channel 1 only, the matrix A10CR9,10,11,12 is open and the matrix A10CR13,14,15, 16 operate in a similar manner to that described for the vertical switches in Paragraph 3-6d. Here, however, the TRIGGER MODE (10) determines the condition of these switches as follows: When the TRIGGER MODE (10) is in Channel 1 only, the matrix A10CR9,10,11,12 is open and the matrix A10CR13,14,15,16 is closed at all times. When the TRIGGER MODE (10) is in composite, the logic is such that the VERTICAL MODE (9) determines the status; e.g., when the VERTICAL MODE (9) is in CH2, the matrix A10CR9,10,11,12 is closed.

3-7. VERTICAL OUTPUT AMPLIFIER (Figure 5-4)

3-7a. A8C20 provides adjustment to the terminating resistors A8R1 and A895. A8Q1 and A8Q2 are used as common base amplifiers. In this way, the input impedance is low and provides power gain to the emitter followers A8Q3 and A8Q4.

3-7b. A8Q5 and A8Q6 function as a differential amplifier with emitter peaking. A8C9 and A8C10 in the emitter circuit provide temperature compensation for this differential amplifier. A8R21 and A8R22 also provide some temperature compensation. A8C8 and A8R17 provide H.F. peaking.

3-7c. A8Q7 and A8Q8 function as emitter followers and drive output amplifiers A8Q9, A8Q10, A8Q11 and A8Q12.

3-7d. A8Q9, A8Q10, A8Q11 and A8Q12 form the differential cascode amplifier which drives the CRT plates. Its bandwidth is adjusted by A8C17 and A8C21. A8R31 and A8R35 provide temperature compensation for this amplifier.

3-7e. When the beamfinder is depressed, A8R14 is unshorted and limits the current available to differential amplifiers A8Q5 and A8Q6. This reduces the dynamic range so that the trace cannot deflect beyond the CRT edge.

3-8. VERTICAL AND TRIGGER LOGIC (Figure 5-5)

3-8a. The trigger pick-off from the preamplifier (A10) is fed into A7Q1 and A7Q2 which function as common base amplifiers. The output of A7Q1 is buffer amplified by A7Q3 and fed to the trigger preamplifiers on the main and delayed sweep circuit boards. A7R1 provides a balance current to adjust the output of A7Q3 to be zero volts d-c.

3-8b. The function of the logic circuits can best be described by describing the trigger modes first, then the vertical modes. As was described in Paragraphs 3-6d and 3-6f, there are diode matrices which are controlled by gates from the logic circuits. These gates are further controlled by the VERTICAL and TRIGGER MODE controls.

3-8c. The TRIGGER MODE (10) determines whether the trigger switches located on A10 are biased continuously in one mode or are biased by the vertical modes. That is, with the TRIGGER MODE (10) in CH1 only, the Channel 1 trigger switch is biased on by connecting it to +15 volts through A7R43 and the Channel 2 trigger switch is biased off by connecting it to −15 volts through A7R42. In this mode, only triggering from Channel 1 is possible. However, with the TRIGGER MODE (10) in DISPLAY, the trigger switches are connected to the bi-stable logic multi formed by A7QB, A7QC, A7Q10 and A7Q11. This multi is controlled by the VERTICAL MODE (9) control; hence, the trigger switches are synchronous with the vertical switches in this mode. CH2 only triggering is also possible.

3-8d. The logic multi formed by A7QB, A7QC, A7Q10 and A7Q11 is controlled by the VERTICAL MODE (9) control as follows; With the VERTICAL MODE (9) on CH1, A7CR4 is connected to −5 volts which turns A7QC and A7Q11 off and A7QB and A7Q10 on. This results in Gate 1 positive and Gate 2 negative, thus turning on the Channel 1 vertical switch and turning off the Channel 2 vertical switch. With the VERTICAL MODE (9) in CH2, A7CR3 is connected to −5 volts which reverses the above situation. Note that if the TRIGGER MODE (10) is in COMPOSITE, the trigger switches would follow the vertical switches such that when CH1 is displayed, triggering occurs on CH1 and when CH2 is displayed, triggering occurs on CH2.

In the added mode, the emitters of A7QB and A7QC are disconnected from −5 volts. This turns A7QB, A7QC, A7Q10 and A7Q11 off which turns on both of the vertical switches on (A10) simultaneously.

When the vertical mode (9) is set to either CH1 or CH2, A7CR10 and A7CR11 are off. This connects the base of A7Q5 to −5V through A7R16 and A7R23 and holds A7CR12 off thus preventing the alternate gate at the emitter of A7QA from getting to the gate multi A7QB, A7QC. With the vertical mode (9) set to ALT, A7CR11 is turned on and A7R16 is now connected to 0V. This turns on A7CR12 and the alternate gate is allowed to pass through A7Q5 to the gate multi A7QB, A7QC. Thus during one sweep, Channel 1 is displayed and during the next, Channel 2 is displayed. When the vertical mode (9) is set to Chop, A7CR10 is turned on and A7R16 is still connected to 0V, thus allowing the alternate gate to appear at the anode of A7CR12. In addition, A7R10, A7R12, and A7R13 are connected to ground. This activates the free-running multi, A7QD and A7QE, which is the chop multi and operates at a frequency of approximately 500 kHz. Thus in this mode, the chop signal is passed through A7CR9 during the sweep interval and causes the display to alternate between Channel 1 and Channel 1 at the 500 kHz rate. When the sweep interval ends, the alternate gate forward biases A7CR12 and reverse biases A7CR9, thus gating the chop signal off during the retrace interval.

3-8e. When the VERTICAL MODE (9) is in the CHOPPED mode, the signal from A7IC1 is also fed to A7Q4. A7Q4 then amplifies this signal and blanks the CRT trace during the transition periods of the chopped waveform.

3-9. MAIN TRIGGER AND SWEEP GENERATOR (Figure 5-6)

3-9a. The trigger signal goes through A1Q1, which is used as a high input impedance buffer amplifier, to the feedback amplifier A1Q2 and A1Q3. The output of this amplifier drives the voltage comparator formed by A1Q4 and A1Q5.

3-9b. Voltage comparator A1Q4, A1Q5 compares the trigger signal with the d-c level selected by the TRIG LEVEL (19) control. Depending on the position of the SLOPE (22) control, it generates a pulse when the positive or negative slope of the trig signal equals the selected level. This current pulse is then fed to tunnel diode A1CR11 which changes states and generates a very fast pulse at the base of A1Q6. Transformer A1T1 inverts this pulse, thus generating a negative trigger pulse which will subsequently trigger the main sweep generator.

3-9c. At this time, assume that the SWEEP MODE (25) switch is in the TRIG position. This biases A1CR16 through A1R41 at approximately 3 ma forward current and .03 volts (Armed). The trigger pulse from A1T1 increases the forward current through A1CR16. A1CR16, a tunnel diode, responds by changing states to a forward drop of approximately 0.5 volts (Sweeping). This in turn causes A1Q14 to conduct and become saturated.

3-9d. The condition of the ramp generator and related circuitry just prior to A1CR16 receiving the trigger pulse is as follows: A1Q14 is not conducting. This causes the voltage at the collector of A1Q14 to go negative and forward bias A1CR20 and A1CR21. A feedback amplifier system now exists between A1Q19, A1Q20, A1Q22 and A1Q21 which holds the collector of A1Q20 at +15 volts. This feedback loop is the sweep start system. When the trigger pulse, discussed in Paragraph 3-9c, causes A1Q14 to conduct, A1CR20 and A1CR21 become back biased and the timing capacitor charges through the timing resistor. A1Q19 and A1Q20 form an integrator which creates a very linear negative sloped ramp at the collector of A1Q20. This ramp causes A1Q21 to turn off; thus, A1Q22 acts as an emitter follower feeding the ramp to A1CR27 which, at the start of sweep, is back biased with the anode end of A1CR27 at approximately +3 volts. Thus, when the ramp from A1Q22 reaches a level of less than +3 volts, CR27 conducts turning on A1Q13.

3-9e. When A1Q13 conducts, it back biases A1CR16 by approximately 1 ma (Hold-off) and maintains this condition until the hold-off capacitor, charging positively at this time, turns A1Q13 off through A1Q17. When this occurs, A1CR16 is forward biased at approximately .03 volts and 3 ma (Armed). This condition is now the same as that in Paragraph 3-9c.

3-9f. This completes one sweep with the exception of a description of hold-off. When A1Q13 turns on, it back biases A1CR16 as described in Paragraph 3-9e. This action causes A1Q14 to turn off which in turn causes A1CR20 and A1CR21 to conduct. The result is that the sweep start system, described in Paragraph 3-9d, is once again connected. Since the collector of A1Q20 is now at approximately +3 volts, because of the completion of the ramp, a finite settling time is required in order for this start system to become linear and active. During this time, it is necessary to prevent any triggers from A1T1 from triggering the sweep system. This is accomplished by holding A1CR16 in the back biased mode during the settling time (Hold-off). Notice that when A1Q14 is conducting, A1Q16 is also conducting. This causes A1CR18 to conduct, thus preventing the hold-off capacitor, C_{HO}, from charging. At the completion of sweep, when A1Q14 turns off, A1Q16 turns off back biasing A1CR18; thus, allowing C_{HO} to charge through R70 and R71. After a finite time, selected to be slightly longer than the settling time, the voltage across C_{HO} turns A1Q13 off through A1Q17. The result is that A1CR16 is biased to the armed mode and the sweep sequence is completed.

3-9g. When the SWEEP MODE (25) is in AUTO, an additional forward bias is applied to A1CR16 through A1R40. This additional current is enough to cause A1CR16 to always go to the 0.5 volts forward bias state. Thus, at the end of the hold-off period, when A1Q13 turns off, A1CR16 immediately goes through the armed mode to the sweep mode. This results in continuous sweeping.

3-9h. With no trigger signal connected, A1Q10 is off resulting in A1CR15 off. This allows the auto mode to function. When a trigger is developed, it causes A1CR11 to change states which causes the collector of A1Q7 to go positive. A1Q8 and A1Q9 form a monostable multivibrator which responds to the positive voltage on the collector of A1Q7 by changing states and turning on A1Q10. This in turn causes A1CR15 to conduct turning A1CR14 off. The auto mode is thus disabled and the sweep can now be triggered instead of free run. The monostable multivibrator formed by A1Q8 and A1Q9 will return to its previous mode, allowing the auto sweep mode to resume, when A1C10 discharges. Since this takes approximately 50 msec, it is necessary to provide triggers at a rate of 20 Hz or greater in order to trigger the sweep in the auto sweep mode.

3-9i. In the SINGLE sweep mode, C_{HO} is connected to −15 volts through A1R42. This prevents C_{HO} from charging and maintains A1CR16 in a back biased condition (Hold-off). Triggered sweeping cannot occur in this mode. When the REARM (26) control is pushed, A1Q12 is turned on by connecting A1C26 through A1R86, A1CR32 and A1R91 to the collector of A1Q12. A1C26 discharges, providing enough energy to cause A1Q12 to turn on and A1Q13 to turn off. In addition, this action causes A1Q11 to saturate and turn on the REARM light A13LT1. When A1Q13 turns off. A1CR16 is forward biased to approximately 3 ma and .03 volts (ARMED). A trigger pulse from A1T1 will cause one sweep to occur.

3-9j. A1Q15 and A1Q16 form a gate which generates: (1) the blanking signal which blanks the CRT on retrace, (2) the alternate sweep gate which is used by the vertical logic circuits to generate the alternate mode, and (3) the gate which ends delayed sweep when the delayed sweep time extends beyond the end of main sweep.

3-9k. In order to increase the apparent duty cycle for low duty cycle signals, a mode is available which ends the main sweep at the end of the delayed sweep time. This is accomplished by feeding the delayed sweep gate through A1CR29 to A1Q12. The effect is to turn off A1Q13 prematurely which ends the main sweep by back biasing A1CR16.

3-10. DELAYED TRIGGER AND SWEEP GENERATOR (Figure 5-7)

3-10a. The input amplifier, comparator and trigger generator in the delayed sweep circuit operate identically as the corresponding circuits in the main sweep circuit. The same is true for the ramp generator. The circuits not required are the auto sweep multi, single sweep circuits and the hold-off circuits. Since the delayed sweep is slaved to the main sweep, these circuits are not necessary.

3-10b. The one circuit necessary in the delayed sweep circuit which is not in the main sweep circuit is the comparator formed by A2Q7. This comparator is used to determine the start of delayed sweep when the HOR MODE (29) is in the INTEN or DELAYED position, and it determines when the delayed sweep is armed for triggering when the HOR MODE (29) is in the TRIG INTEN or TRIG DELAYED mode.

3-10c. The main sweep ramp reaches the comparator through A2R28. It is compared with the d-c level set by the DELAY VERNIER (35) control, A14R3. When the ramp level goes below this d-c level, A2Q7 causes A2CR11 to change states which subsequently turns A2Q20 on. This turns A2Q13 on and A2Q14 off. When A2Q14 is turned off, it no longer back biases A2CR18.

3-10d. The forward bias current of A2CR18 is determined by A2R50 alone when the HOR MODE (29) is in the TRIG INTEN or TRIG DELAYED modes and is approximately 3 ma and .03 volts (ARMED). Any trigger from A2T1 will cause the ramp generator to function by causing A2CR18 to change states to approximately 0.5 volts (Sweeping). When the HOR MODE (29) is in the INTEN or DELAYED mode, additional current is supplied by A2R27 such that when A2Q14 is turned off, A2CR18 automatically goes to a forward bias of 0.5V and causes the ramp generator to function.

3-10e. A2Q10 and A2Q11 form a gate which generates: (1) the strobe to brighten the CRT trace during the INTEN and TRIG INTEN modes, (2) the blanking pulse to blank the CRT during retrace during the DELAYED and TRIG DELAYED modes, and (3) the gate through A2Q9 which ends main sweep during the DELAY ENDS MAIN mode of the MAIN SWEEP LENGTH (50) control.

3-11. HORIZONTAL OUTPUT AMPLIFIER (Figure 5-8)

3-11a. The horizontal amplifier receives either the main sweep ramp, the delayed sweep ramp or an external signal connected to the EXT HOR (24) connector depending on the setting of the HOR MODE (29) control.

3-11b. A3Q1 and A3Q2 act as feedback amplifiers and provide a very low input impedance. They drive the differential amplifier formed by A3Q3 and A3Q4.

3-11c. The gain of the differential amplifier, A3Q3 and A3Q4, is determined by the emitter circuits as follows: With the X10 GAIN (37) pushed in the gain is determined by A3R20 and A3R22. With the X10 GAIN (37) pulled out, the gain is increased ten times and is controlled by A3R14 and A3R16.

3-11d. A3CR3, A3CR6, A3CR7, A3CR8, A3CR11 and A3CR12 provide overload protection and prevent the CRT trace from returning on screen during excessive overloads.

3-11e. A3Q5, A3Q7 and A3Q8 form a feedback amplifier which drives one of the horizontal deflection plates. A3Q6, A3Q9 and A3Q10 form another feedback amplifier which drive the other horizontal deflection plate. There is in addition cross coupling through A3C9. The action of A3C9, A3C8 and A3C10 is to adjust the sensitivity and linearity of this output amplifier system at high frequencies.

3-11f. When BEAMFINDER (41) is depressed, A3CR9 and A3CR10 are forward biased and limit the dynamic range of the amplifier so that the CRT beam cannot be deflected off screen.

3-12. CALIBRATOR (Figure 5-8)

3-12a. A3Q11 and A3Q12 form a free running multivibrator which oscillates at approximately 1 KHz. A3Q13 enables the leading and falling edges of the square wave to be less than 1 μsec by providing a low impedance path for A3C14 to discharge through when A3Q12 turns off. A3R48, A3R49 and A3R50 act as voltage dividers and determine the basic accuracy of the calibrator.

3-13. UNBLANKING AMPLIFIER (Figure 5-8)

3-13a. The input signals to A3Q14 are current summed at the emitter of A3Q14. A3Q14 drives the output amplifier whcih subsequently drives one of the secondaries of the H.V. transformer. (Fig. 5-11)

3-13b. A3Q15, A3Q16 and A3Q17 form a feedback amplifier which provides high dynamic range and bandwidth.

3-13c. A3CR21 and A3CR22 prevent any transients from the H.V. supply from destroying the output amplifier, A3Q16 and A3Q17.

3-13d. When the BEAMFINDER (41) is depressed, A3CR16 is connected to −15V. This overrides any of the inputs to A3Q14 and provides a very bright CRT trace.

3-14. L.V. SUPPLY (Figure 5-11)

3-14a. The +15V supply is the main supply and is the basic reference for the other supplies. It uses a T.C. reference zener for stable temperature performance, A5CR9.

3-14b. A5IC2 is a high gain operational amplifier. It senses any change in the +15V output by comparing the voltage at Pin 2 with that at Pin 3. Any difference is amplified and fed through A5Q3 to Q2 for correction. A5Q4 provides overload protection. It senses the load current by monitoring the voltage across A5R11. When this current exceeds approximately 600 ma, A5Q4 conducts and limits the current.

3-14c. The −15V supply is referenced to the +15V supply through A5R13. A5IC3 operates in the same manner as A5IC2 in Paragraph 3-14b and A5Q5 operates in the same manner as A5Q4 in Paragraph 3-14b.

3-14d. The +100V supply is referenced to the −15V supply through A5R23 and A5R24. A5IC1 and A5Q2 operate as described in Paragraph 3-14b.

3-14e. A5CR8 is a zener diode and is used to maintain Pin 6 of A5IC1 at approximately 0 V. A5CR7 protects A5IC1 and A5CR8 from overloads on the +100V supply.

3-15. H.V. SUPPLY (Figure 5-12)

3-15a. A12Q1 and A12T1 form an oscillator which oscillates at approximately 40 KHz. The turns ratio from primary to secondary is very high thus producing a very large p-p signal at Pins 6, 5 and 8 of A12T1. The signal at Pin 6 is rectified by A12A6CR4 and filtered by A12A6C4 and A12A6C5 producing a voltage of −1150 VDC which supplies the cathode the CRT. The signal at Pin 8 is rectified by A12A6CR3 and filtered by A12A6C6 and A12A6C7 producing a voltage of −1150 VDC between this output and Pin 9. The blanking gate is connected to Pin 9 of A12T1, therefore, the voltage differential between the grid and cathode is variable and controls the intensity of the CRT trace.

3-15b. The voltage at the cathode of the CRT is compared to the +100V supply by the differential amplifier A12A6Q1 and A12A6Q2. Any difference is amplified and the drive to the base of A12Q1 is changed with the result of maintaining the cathode voltage of the CRT at −1150V.

3-15c. The voltage at Pin 5 of A12T1 is fed into a H.V. tripler which provides approximately +10,800 V to supply the post accelerator of the CRT.

Section 4

Maintenance

4-1. INTRODUCTION

4-1a. This section contains all the information required to maintain the model 1062 Oscilloscope. The specific items outlined are:

a. Assembly and component identification.
b. Required test equipment.
c. Performance checks.
d. Adjustment and calibration procedure.

4-2. ASSEMBLY AND COMPONENT IDENTIFICATION

4-2a. Figures 4-1 and 4-2 identify the physical locations of the various subassemblies.

Table 4-1 identifies the subassembly functions and schematic locations.

4-2b. Components are identified by their designation numbers.

Any part can be quickly located by going to the figures referred to in paragraph 4-2a, to get first the physical location of the subassembly and location of the schematic, and secondly, from the schematic the physical location of the part on the subassembly.

4-3. REQUIRED TEST EQUIPMENT

Table 4-2 is a list of test equipment required in order to maintain the 1062. Also on this table is a list of pertinent specifications if a substitution has to be made for the recommended piece of equipment.

Table 4-1

Assy	Description	Schematic Figure
A1	Main Trigger and Sweep P.C. assy	5-6
A2	Delayed Trigger and Sweep P.C. assy	5-7
A3	Horizontal output, Z axis and Calibrator P.C. assy	5-8
A4	Vertical attenuator assy	5-2
A5	Low Voltage power supply P.C. assy	5-11
A12 A6	High Voltage Power supply P.C. assy	5-12
A7	Vertical Mode Logic P.C. assy	5-5
A8	Vertical Output P.C. assy	5-4
A4 A9	Vertical attenuator P.C. assy	5-2
A10	Vertical Pre-amplifier P.C. assy	5-3
A11	Timing Switch assy	5-9
A12	High Voltage assy	5-12
A13	Front Panel Assy (lower)	5-2,5-3,5-6, 5-7,5-8,5-11, 5-12
A14	Front Panel assy (upper)	5-9,5-10
A4 A15	Vertical Attenuator switch assy	5-2

Table 4-2

Instrument Type	Pertinent Specs.	Use	Instrument Recommended
RF Voltmeter	range: 0.1 vrms to 10 vrms frequency: 10 KHz to 500 MHz	para: 4-5	Boonton Electronics 91-DA
10 dB Attenuator	VSWR: 1.1:1 up to 250 MHz	para: 4-5, 4-23	General Radio 874-G10
Feedthru Voltmeter "Tee"	————————	para: 4-5	Boonton Electronics 91-14A
50Ω feedthru termination	Value: 50Ω ± 2Ω VSWR: 1.1:1 up to 250 MHz	para: 4-5, 4-8, 4-13, 4-14, 4-15, 4-16	Hewlett Packard 10100A
Signal Generator	freq: 50 KHz to 60 MHz Level: continuously variable from 50 mv to 1 v p-p	para: 4-5, 4-8, 4-13, 4-14	Tektronix 191
AC-DC Voltage Calibrator	Level: 30 mv to 100 v p-p accuracy: 0.2%	para: 4-6	Hewlett Packard 738 AR, BR
Time Mark generator	time accuracy: ±0.001% time intervals: 5 sec to 1 μsec frequency outputs: 5, 10, 50 MHz	para: 4-10, 4-11, 4-22	Tektronix 2901
Audio Oscillator	Level: 30 mv to 1.5 v p-p freq: 100 Hz to 5 MHz	para: 4-13, 4-15	Hewlett Packard 651A
Pulse generator	Level: −2 v Width: 70 nsec rise/fall time: 10 nsec	para: 4-16	Hewlett-Packard 8002A
Digital Voltmeter	range: 15 v to 150 v accuracy: ±0.2%	para: 4-21, 4-22 4-23	Hewlett Packard 3430
H.V. Voltmeter	range: ±2.5 vdc input resistance: 150 M	para: 4-21	Sensitive Research DCH1
Voltmeter	range: 1 KV to 10 KV input resistance: 50 K	para: 4-23	Simpson 261,270
Square Wave generator	frequency: 10 KHz Level: 2 to 40 volts rise/fall time: 10 nsec	para: 4-23	Tektronix 106
Pulser	risetime: 1 nsec ripple: ±2% width: ⩾ 100 nsec Impedance: 50Ω Level: 0.1 to 1 v p-p	para: 4-23	Hewlett Packard 8000A
L-C meter	range: ⩽ 30 pf	para: 4-23	Tektronix 130
Adaptors (2 ea)	GR to BNC (female)	———	General Radio 874
Cables (2 ea)	BNC (male) to BNC (male) approx 3 to 4 feet long	———	————
Cables (2 ea)	BNC (male) to BNC (male) Less than 4 inches long	———	————

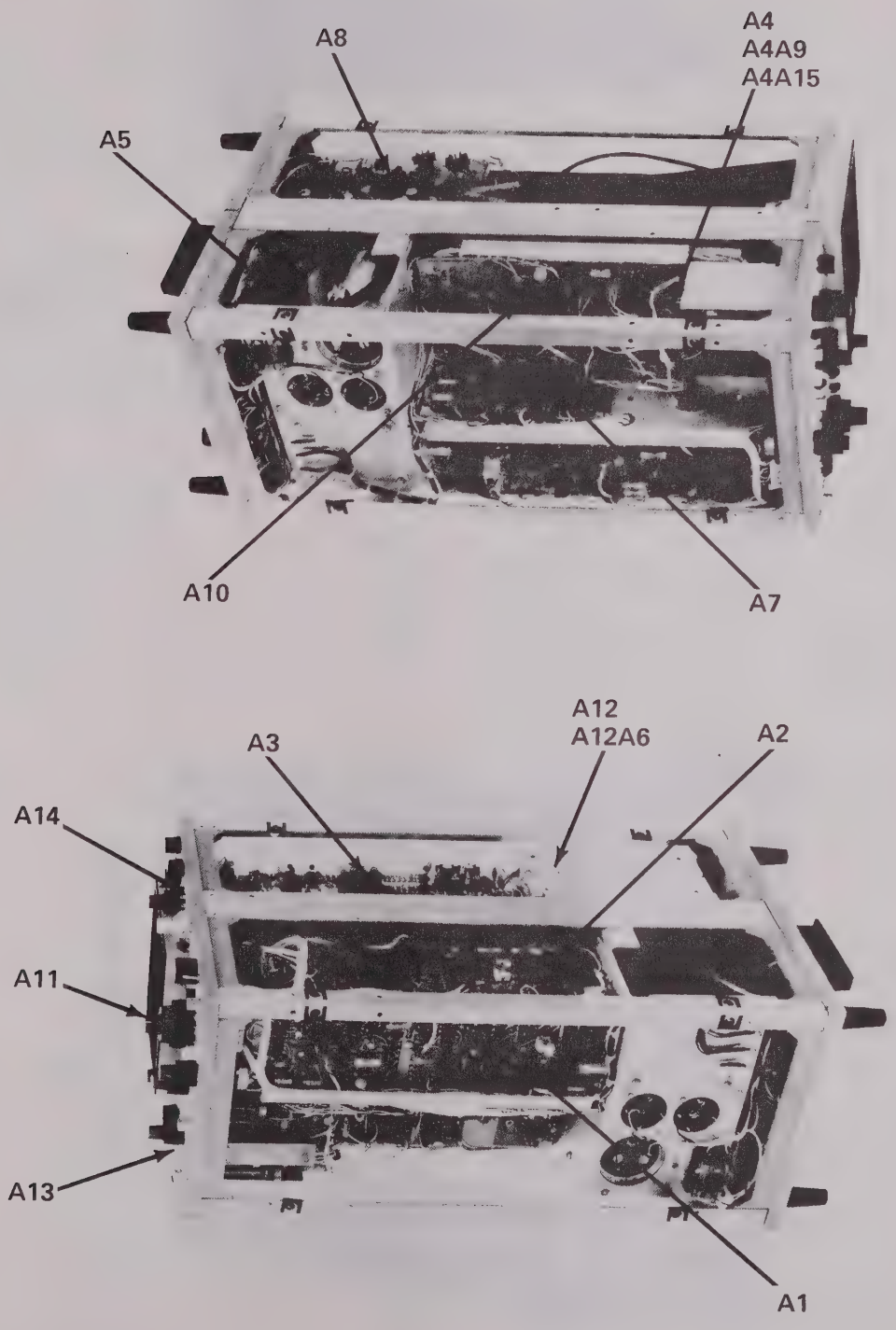


Figure 4-1. 1062 Assembly Locations

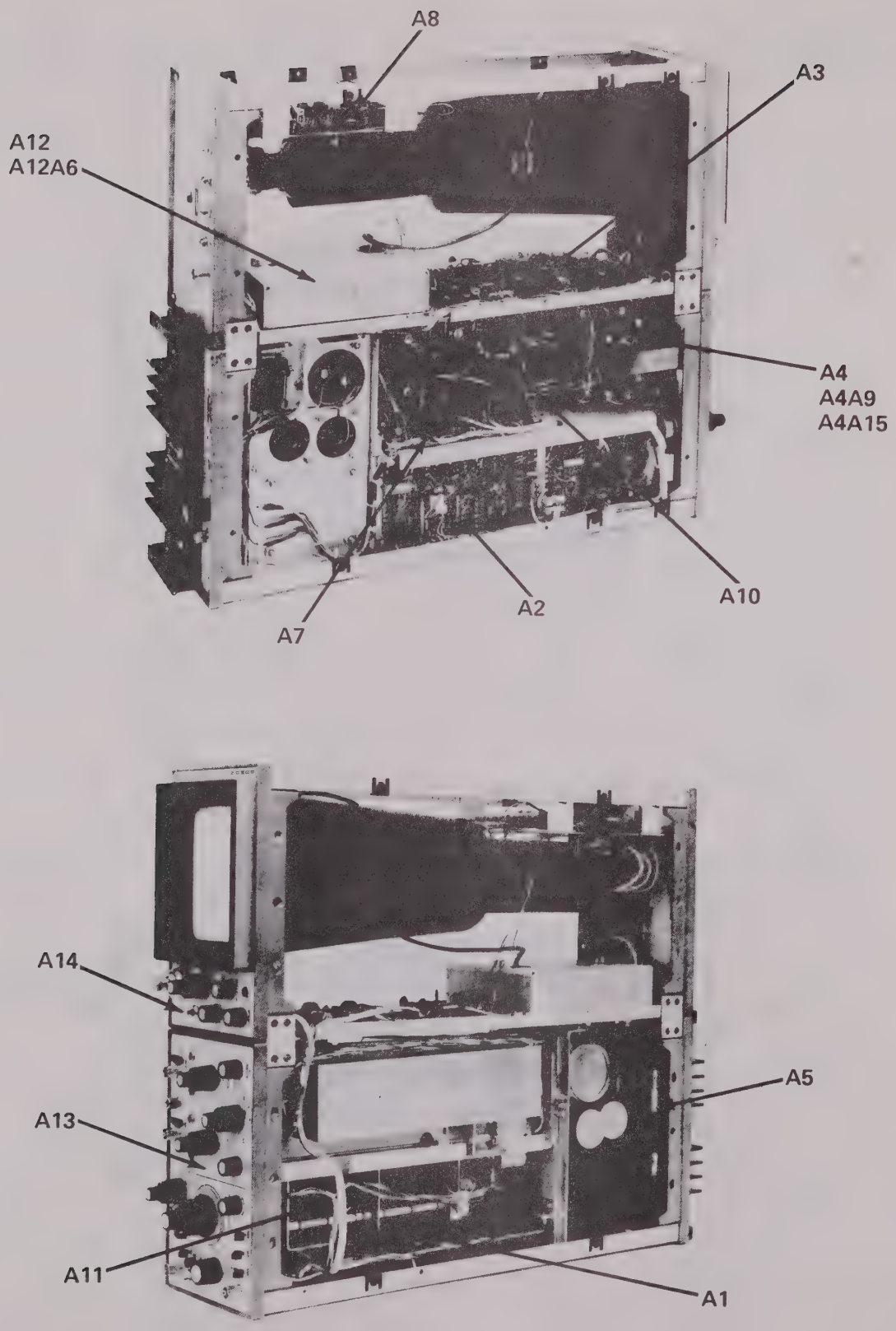


Figure 4-2. R1062 Assembly Locations

4-4. PERFORMANCE CHECK

4-4a. Paragraphs 4-5 through 4-16 recommend methods to verify the model 1062 specifications outlined in the beginning of this manual. It is important to allow approximately 15 minutes of warm-up time prior to starting these performance checks. These performance checks, in addition to providing verification of the 1062 specifications, also can be used to locate problem areas when the 1062 is malfunctioning. Before starting performance checks, read Sections 2-5 and 2-6 so as to be thoroughly familiar with the functions of the 1062.

4-4b. In each section of the performance checks, there is a list of 1062 control settings. These settings relate only to the area being checked; e.g., when checking for vertical bandwidth, only the vertical controls are described. The horizontal controls settings are set by using the guides described in Sections 2-5 and 2-6.

4-4c. INITIAL SETTINGS.

AC-GND-DC (5) (14) ..... DC
VERNIER (7) (13) ..... CAL.
VERTICAL MODE (9) ..... Ch 1
TRIG MODE (10) ..... DSPLY
COUPLING (21) (33) ..... AC
SLOPE (22) (32) ..... +
SOURCE (23) (31) ..... INT
SWEEP MODE (25) ..... AUTO
HORIZ MODE (29) ..... NORM
VERNIER (28) ..... CAL.
X10 GAIN (37) ..... Push in.
MAIN SWEEP LENGTH (50) ..... FULL

4-5. HIGH FREQUENCY BANDWIDTH

Specification: 3 dB down, DC to 60 MHz (x1 Gain)

4-5a. Connect up Scope as shown in Figure 4-3.

4-5b. Set 1062 controls:
VERT MODE (9) – channel being tested
VOLTS/DIV (6) (12) –0.1

4-5c. Set frequency of signal generator to 50 KHz and set level to give a full 8 cm deflection on the 1062 CRT. Record reading on RF voltmeter.

4-5d. Set frequency of signal generator to 60 MHz.

4-5e. Adjust level of signal generator to give the same reading recorded in Step 4-5c above.

4-5f. Deflection on 1062 CRT should be greater than 5.6 divisions. This verifies the DC to 60 MHz spec.

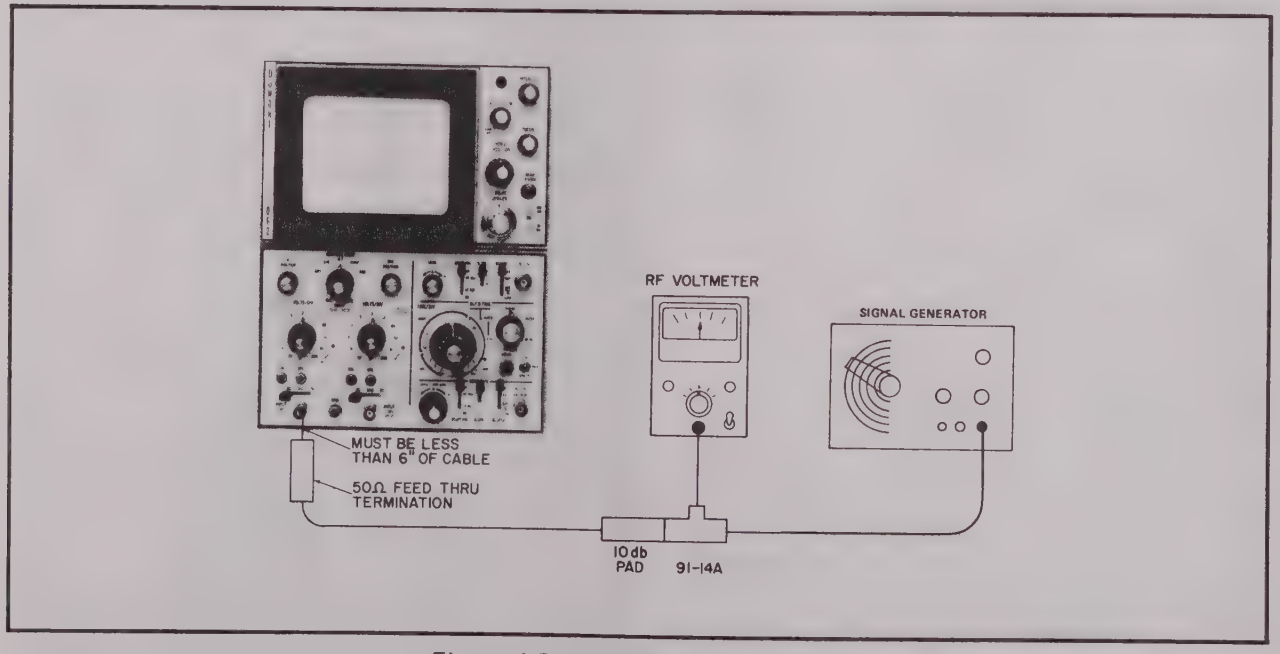


Figure 4-3. H.F. Bandwidth Set-Up

4-6. DEFLECTION FACTOR

Specification: 5mV/div to 10V/div in 11 calibrated steps 1, 2, 5 sequence.

4-6a. Connect as in Figure 4-4.

4-6b. Set 1062 controls:
VERTICAL MODE (9) – channel being tested
VOLTS/DIV (6) (12) – .005
VERNIER (7) (13) – CAL

4-6c. Set calibrator to .03V p-p.

4-6d. Adjust CAL (3) (16) to give 6 cm of deflection.

4-6e. Change level of calibrator and 1062 sensitivity as indicated in Table 4-3.

TABLE 4-3

CALIBRATOR V P-P	SENSITIVITY Volt/cm	CRT DEFLECTION cm
.030	.005	6 ± .18
.060	.01	6 ± .18
.120	.02	6 ± .18
.300	.05	6 ± .18
.600	.1	6 ± .18
1.20	.2	6 ± .18
3.00	.5	6 ± .18
6.00	1	6 ± .18
12.00	2	6 ± .18
30.00	5	6 ± .18
60.00	10	6 ± .18

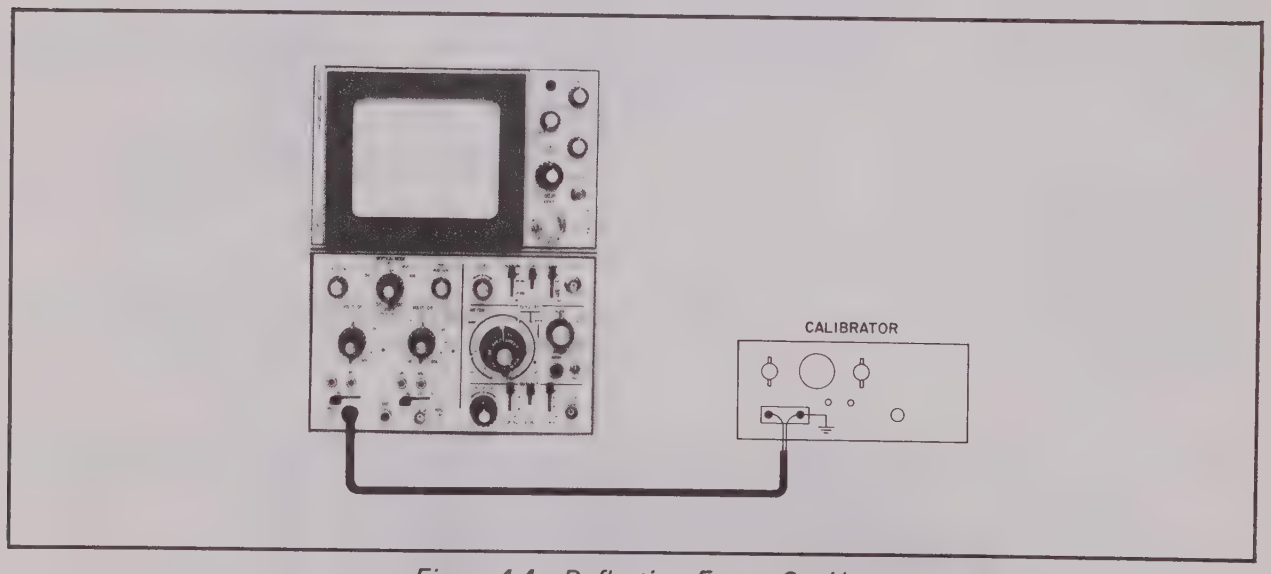


Figure 4-4. Deflection Factor Set-Up

4-7. VERNIER

Specification: 2.5:1 change in sensitivity.

4-7a. Set up as in Figure 4-5.

4-7b. Set 1062 controls:
VERT MODE (9) – channel being tested.
VOLTS/DIV (6) (12) – 0.1
VERNIER (7) (13) – CAL

4-7c. There should be 6 cm of deflection at this time.

4-7d. Turn VERNIER (7) (13) ccw. There should be less than 2.4 cm of deflection.

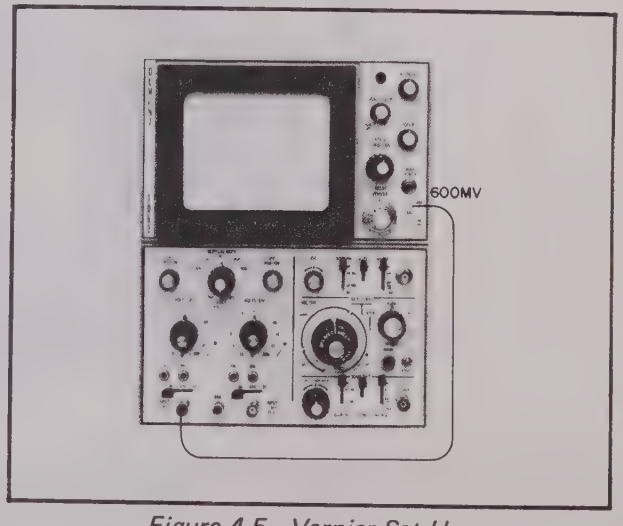


Figure 4-5. Vernier Set-Up

4-8. COMMON MODE REJECTION RATIO

Specification: CMRR is greater than 20:1 in ADD mode, DC to 2 MHz. Common mode signal not to exceed 10 times the setting of the volts/div switch.

4-8a. Connect as in Figure 4-6 with same signal going in each channel.

4-8b. Set 1062 controls to:
VERT MODE (9) – ALT
INVERT (13) – pull
VOLTS/DIV (6) (12) – 0.1

4-8c. Set Signal Generator to produce 1 cm of deflection at a frequency of 50 KHz.

4-8d. Set VERT MODE (9) to add and change VOLTS/DIV (6) (12) to 0.01 on each channel. Adjust channel 1 or channel 2 VERNIER (7) (13) to give a null on the CRT. DO NOT ADJUST VERNIER AGAIN.

4-8e. Set frequency of Generator to 2 MHz and note that deflection on CRT is less than 0.5 cm.

4-9. VERTICAL MODES

Specification: Channel 1 only. Channel 2 only, ALT, CHOP, ADD.

4-9a. Connect calibrator, 600 mv, to channel 1 and channel 2.

4-9b. Set 1062 controls:
VERT MODE (9) – CH 1
TRIG MODE (10) – DSPLY
VOLTS/DIV (7) (13) – 0.1
HOR MODE (29) – Norm
TIME/DIV (27A) – 0.2 msec/div
INVERT (13) – push in

4-9c. A trace of the calibrator should be present on the screen. Adjust VERNIER (7) to give 4 cm of deflection.

4-9d. Set VERT MODE (9) to CH 2 and repeat step 4-9c.

4-9e. Set VERT MODE (9) to Alternate, and by moving Channel 1 and 2 POSITION (8) (11) verify that both traces are synchronized and that positioning does not affect triggering.

4-9f. Set VERT MODE (9) to Add and verify that the signal is now 8 cm high. Pull the INVERT (13) and verify cancellation, i.e.; a very small signal.

4-9g. Set VERT MODE (9) to chop and TRIG MODE (10) to CH 1. Verify two traces.

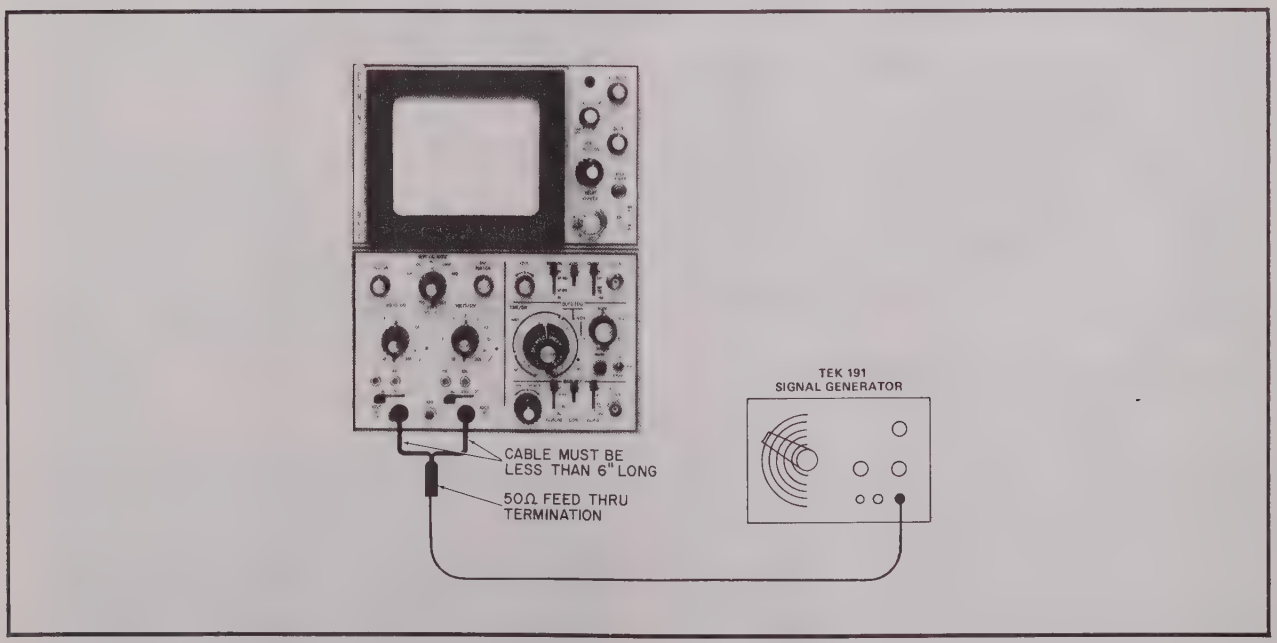


Figure 4-6. Common Mode Rejection Ratio Set-Up

4-10. MAIN & DELAYED SWEEP RANGES

Specification: 0.1 μs/div to 1 sec/div in 21 calibrated steps, 1, 2, 5 sequence. Accuracy ± 3%. x10 Gain 10 μsec/div ± 2%.

4-10a. Connect as in Figure 4-7.

4-10b. Set 1062 controls:
VERT MODE (9) – CH 1
TRIG MODE (10) – CH 1
TRIG SOURCE (23) – INT
HORIZ MODE (29) – NORM
VERNIER (28) – CAL
COUPLING (21) – AC
SWEEP MODE (25) – TRIG
AC-GND-DC (5) – DC

4-10c. Set time mark generator and TIME/DIV (27A) control as indicated below. Set one time mark on the 1st graticule. The 8th or 16th time mark, counting from the time mark on the 1st graticule, as indicated in Table 4-4, should be on the ninth graticule within the tolerance given below. See Figure 4-8.

4-10d. Set time mark generator to give a 5 MHz signal and set TIME/DIV (27A) to 0.5 μsec/div. There should be 20 cycles between the 1st and 9th graticules ± 0.3 cm. With the TIME/DIV (27A) at 0.2 μsec/div, there should be 8 cycles ± 0.3 cm, and with the TIME/DIV (27A) at 0.1 μsec/div, there should be 4 cycles ± 0.3 cm.

4-10e. With TIME/DIV (27A) at 0.1 μsec/div, set the time mark generator to 50 MHz and pull the x10 (37) control. There should be 4 cycles between the 1st and 9th graticule. Here the tolerance is an additional ± 2%. The error here is now ± 0.5 cm.
NOTE: *It is important that the HOR POSITION (36) be at its midrange position.*

4-10f. Set the TIME/DIV (27A) to 1 μsec/div, push in x10 GAIN (27) and set the time mark generator to 1 μsec. There should be a time mark on every major graticule line; i.e., 11 marks. Turn the VERNIER (28) CCW. There should be more than 28 marks at this time.

4-10g. The main Time base, Vernier, and x10 horizontal gain are now verified.

4-10h. Set 1062 controls same as b above except:
HORIZ MODE (29) – DLYD

4-10i. Repeat steps c-f. In this case, however, change the TIME/DIV (27B) in accordance with table 4-4. Since the TIME/DIV (27A) still controls the main sweep, varying the TIME/DIV (27B) only, will cause the trace to become dim as faster sweep time occurs. In order to avoid this, every time a 1, 2, 5 sequence is completed, bring the TIME/DIV (27A) control up to the TIME/DIV (27B) control.

4-10j. The delayed sweep is now verified.

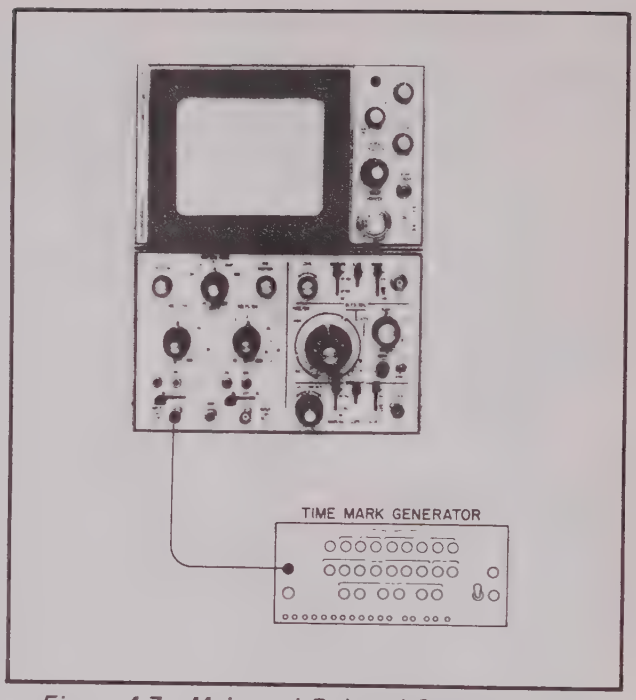


Figure 4-7. Main and Delayed Sweep Set-Up

TABLE 4-4

TIME MARK	TIME MARK GENERATOR	TIME/div (27A)	READING cm
9th	1 sec	1 sec/div	9 + 0.3
9th	.5	.5	9 + 0.3
18th	.1	.2	9 + 0.3
9th	.1	.1	9 + 0.3
9th	50 msec	50 msec/div	9 + 0.3
18th	10	20	9 + 0.3
9th	10	10	9 + 0.3
9th	5	5	9 + 0.3
18th	1	2	9 + 0.3
9th	1	1	9 + 0.3
9th	.5	.5	9 + 0.3
18th	.1	.2	9 + 0.3
9th	.1	.1	9 + 0.3
9th	50 μsec	50 μsec/div	9 + 0.3
18th	10	20	9 + 0.3
9th	10	10	9 + 0.3
9th	5	5	9 + 0.3
18th	1	2	9 + 0.3
9th	1	1	9 + 0.3

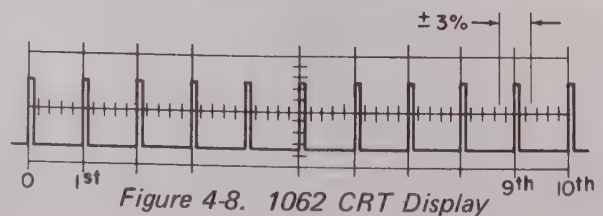


Figure 4-8. 1062 CRT Display

4-11. SWEEP DELAY AND JITTER

Specification: incremental accuracy ± 0.3%. Jitter is less than 1 part in 20,000 of 10x main time/div setting.

4-11a. Connect as in Figure 4-9.

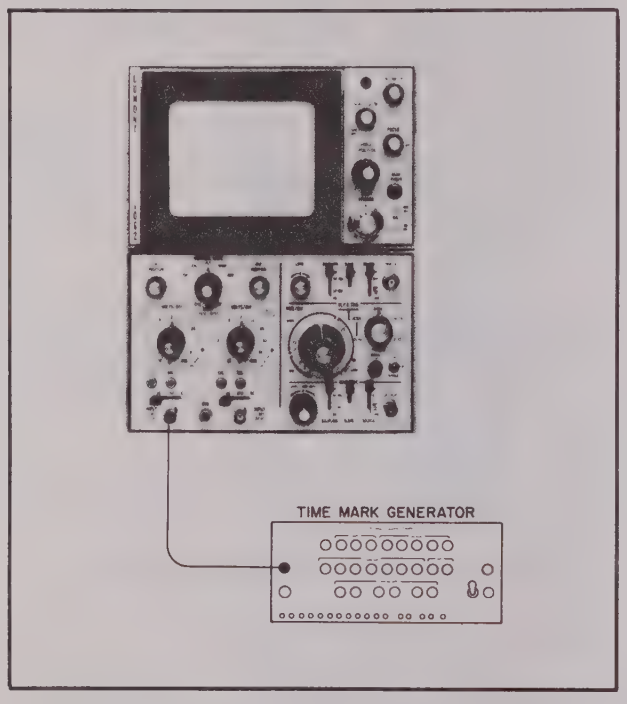


Figure 4-9. Sweep Delay and Jitter Set-Up

4-11b. Set 1062 controls:
VERT MODE (9) – CH 1
TRIG MODE (10) – CH 1
SWEEP MODE (25) – AUTO
HOR MODE (29) – INTEN
TIME/DIV (27A) – 1 msec/div
TIME/DIV (27B) – 10 μsec/div

4-11c. Set the time mark generator to 1 msec.

4-11d. Adjust DELAY VERNIER (35) so that intensified area is on the time mark at the 1st graticule line. Set HOR MODE (29) to DLYD and readjust DELAY VERNIER (35) so that the leading edge of the time mark is on the 5th graticule. *Record* the reading of the DELAY VERNIER (35) setting.

4-11e. Repeat steps b through d except now place the intensified area on the time mark at the 5th graticule line.

4-11f. Repeat steps b through d again, except now place the intensified area on the time mark at the 9th graticule line.

4-11g. Subtract the reading in d from the reading in f and divide this result by 2; then add to this the reading in d. Compare this result with the reading in e. They should not differ by more than .06 cm.

EXAMPLE

STEP	READING
d.	.94
e.	4.84
f.	8.85

$$\frac{8.85 - .94}{2} = 3.955 + .94 = 4.895$$

$$4.895 - 4.84 = .055 \text{ cm}$$

The incremental accuracy is now verified.

4-11h. Set up as in b and c above, and adjust DELAY VERNIER (35) to intensify the 6th time mark.

4-11i. Set TIME/DIV (27B) to 1 μsec/div and HOR MODE (29) to DLYD. Adjust the DELAY VERNIER (3) very carefully to center time mark and verify that leading edge jitter is less than 0.5 cm. See Figure 4-10 below.

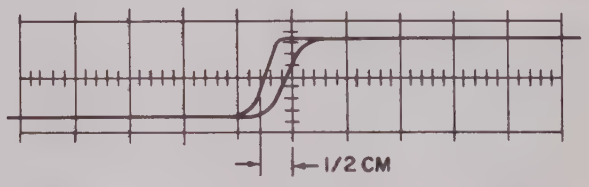


Figure 4-10. 1062 CRT Display

4-12. DISPLAY MODES

Specification: HOR MODE – NORMAL, INTEN, DLYD, TRIGGERED INTEN, TRIGGERED DLYD, EXT HOR.
SWEEP MODE – AUTO, TRIG, SINGLE

4-12a. Connect as in Figure 4-11.

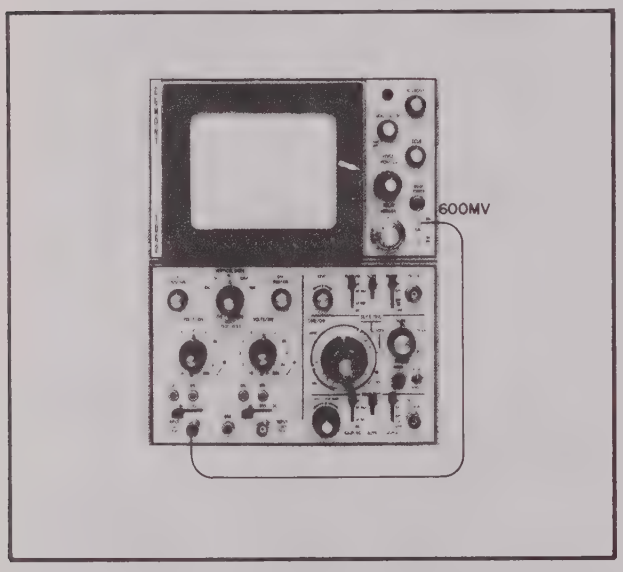


Figure 4-11. Display Modes Set-Up

4-12b. Set 1062 controls:
SOURCE (23) (31) – INT
VOLTS/DIV (6) – 0.2
AC-GND-DC (5) – AC
VERT MODE (9) – CH 1
SWEEP MODE (25) – Auto
TIME/DIV (27A) – 1 msec/div
TIME/DIV (27A) – 0.1 msec/div
HOR MODE (29) – Normal
DELAY VERNIER (35) – 1.00

4-12c. At this time the calibrator trace should be present on screen. Set HOR MODE (29) to INTEN and observe a trace with an intensified region starting at about the 1st graticule and with 1 cm of duration.

4-12d. Placing the HOR MODE (29) to DLYD, should expand the intensified portion in c above to full screen size.

4-12e. Set HOR MODE (29) to DLYD TRIG INTEN and vary LEVEL (34) to give a trace with an intensified position.

NOTE: *As the LEVEL (34) control is rotated through its range, the intensified portion should disappear at the extremities of this range.*

4-12f. Positioning HOR MODE (29) to DLYD TRIG DLYD should have the same effect as in d above.

4-12g. Position HOR MODE (29) to EXT HOR, SOURCE (23) to line, and AC-GND-DC (5) to GND. At this time a trace should be present. Varying HOR GAIN (19) should change the length of this trace.

4-12h. Set up as in a and b above. Adjust LEVEL (19) until trace loses synchronism. Set SWEEP MODE (25) to TRIG. The trace should disappear at this time. Readjust level (19) until a synchronized trace appears to verify that the TRIG mode functions.

4-12i. Set SWEEP MODE (25) to SINGLE, TIME/DIV (27A) to 0.1 sec/div, and SOURCE (23) to EXT. At this time no trace should be present. Depress REARM (26). Still no trace should be present; however, the REARM light should be lit.

4-12j. Set SOURCE (23) to INT. This should cause one sweep to occur.

4-13. INTERNAL TRIGGER SENSITIVITY

Specification: 0.5 div Vertical deflection
AC – 4 Hz to 50 MHz
DC – dc to 50 MHz
LF-REJ – 30 KHz to 50 MHz
HF-REJ – 4 Hz to 50 KHz

4-13a. Connect as in Figure 4-12.

4-13b. Set 1062 controls:
VERT MODE (9) – CH 1
TRIG MODE (10) – DSPLY
HOR MODE (29) – Norm
SWEEP MODE (25) – TRIG
SOURCE (23) – INT
COUPLING (21) – DC
TIME/DIV (27A) – 10 μsec/div
VERNIER (7) (13) – CAL

4-13c. Set sig gen at 50 KHz, and 0.5 cm of vertical deflection. Vary LEVEL (19) to verify that a triggered sweep is achievable. Repeat with the signal generator at 50 MHz.

4-13d. Reset controls as in step b above, set COUPLING (21) to HF REJ, & set gen to 10 KHz. Vary both the sig generator level and the LEVEL (19) control until further reduction in the generator level causes loss of synchronism.

Without changing signal level increase frequency to 100 KHz and observe a loss of synchronism.

4-13e. Repeat step d with COUPLING (21) set to LF REJ and starting at 100 KHz switching to 10 KHz.

4-14. EXTERNAL TRIGGER SENSITIVITY

Specification: 50 mv peak to peak level
DC – dc to 60 MHz
AC – 4 Hz to 60 MHz
LF – REJ - 30 KHz to 60 MHz
HF REJ – 4 Hz to 50 KHz

4-14a. Set up as in Figure 4-13.

4-14b. Set 1062 controls:
VERT MODE (9) – CH 1
SWEEP MODE (25) – TRIG
SOURCE (23) – EXT
HOR MODE (29) – NORM
COUPLING (21) – DC
TIME/DIV (27A) – 1 msec/div

4-14c. Set signal generator to 50 KHz and 50 mv – peak to peak and adjust LEVEL (19) until a stable trace is present. Repeat with signal generator at 60 MHz.

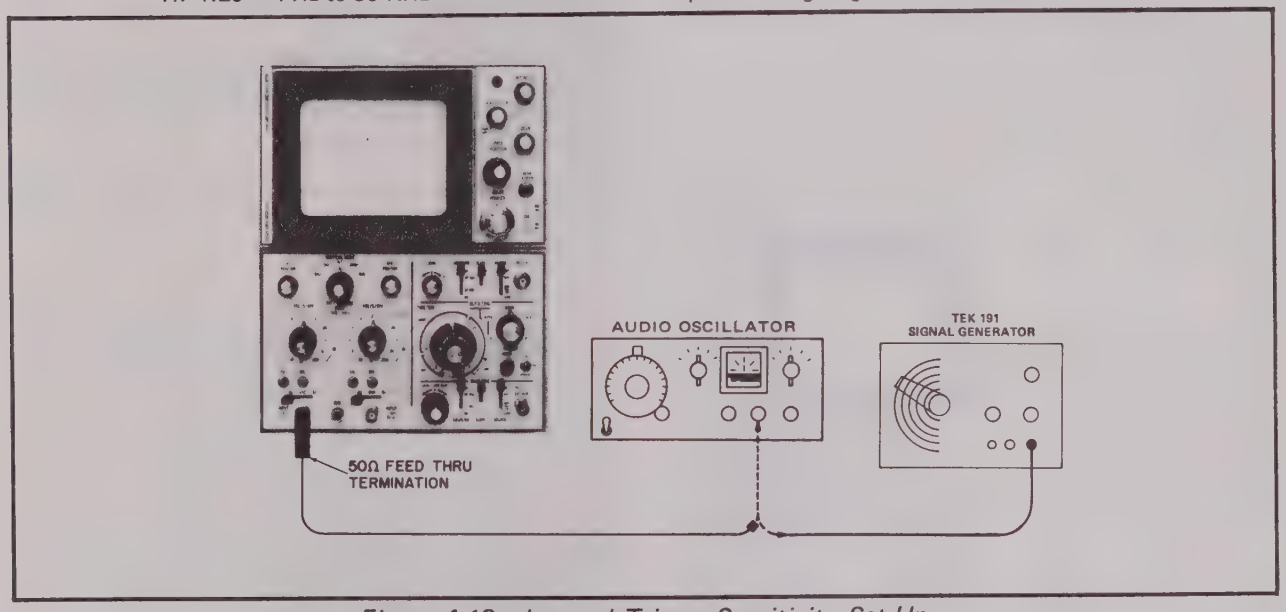


Figure 4-12. Internal Trigger Sensitivity Set-Up

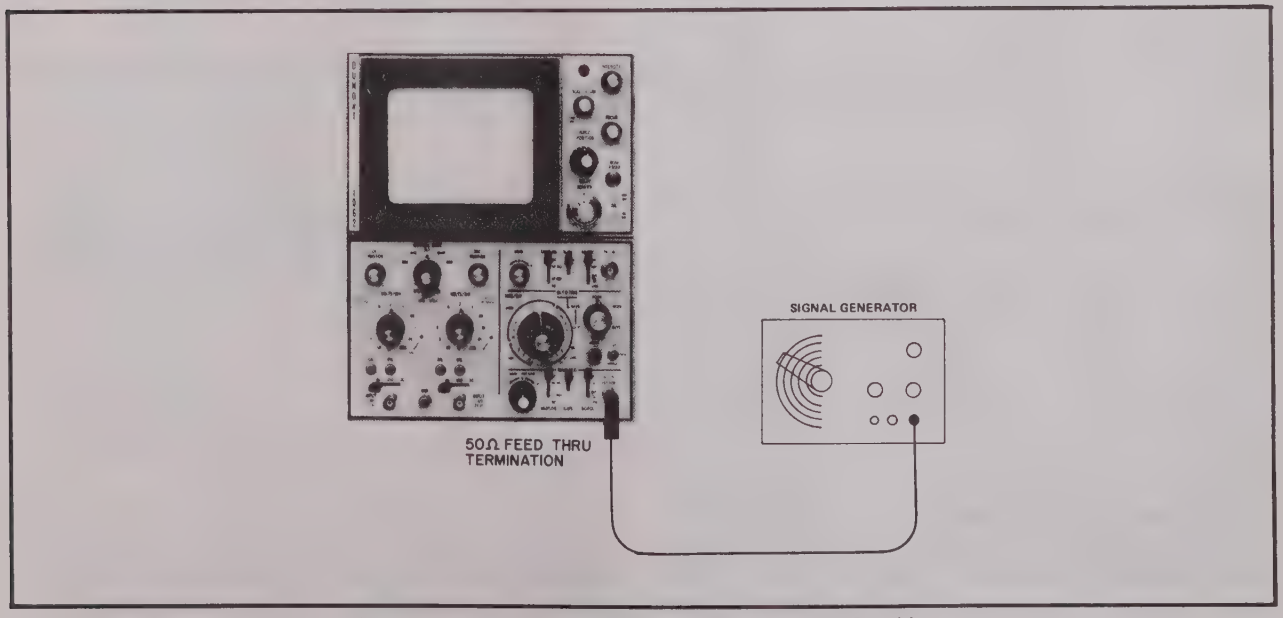


Figure 4-13. External Trigger Sensitivity Set-Up.

4-15. EXTERNAL HORIZONTAL AMPLIFIER

Specification: Bandwidth – DC to 4 MHz
Deflection factor –
x1 120mv/div to 1.2v/div
x10 12mv/div to 120mv/div
÷10 1.2v/div to 12v/div

4-15a. Connect as in Figure 4-14.

4-15b. Set 1062 controls:
VERT MODE (9) – CH 1
HOR MODE (29) – EXT HOR
SOURCE (23) – EXT
HOR POS (37) – push in
HOR GAIN (19) – CW
COUPLING (21) – AC

4-15c. Set audio oscillator frequency to 50 KHz and adjust amplitude to give 10 cm of deflection. Verify that at 4 MHz there is greater than 7 cm of deflection.

4-15d. Reset frequency to 50 KHz. Verify that with the audio oscillator set at 1.2V peak to peak there is greater than 10 cm of deflection with the HOR GAIN (19) control CW and that there is less than 1 cm of deflection with the HOR GAIN (19) control CCW.

4-15e. Repeat d. except pull x10 GAIN (37) and set signal generator to 120 mv peak to peak.

4-15f. Push in x10 GAIN (37) and set audio oscillator 1.2V p-p at 50 KHz. Adjust HOR GAIN (19) for 10 cm of deflection. Set SOURCE (23) to EXT÷10 and verify approximately 1 cm of deflection.

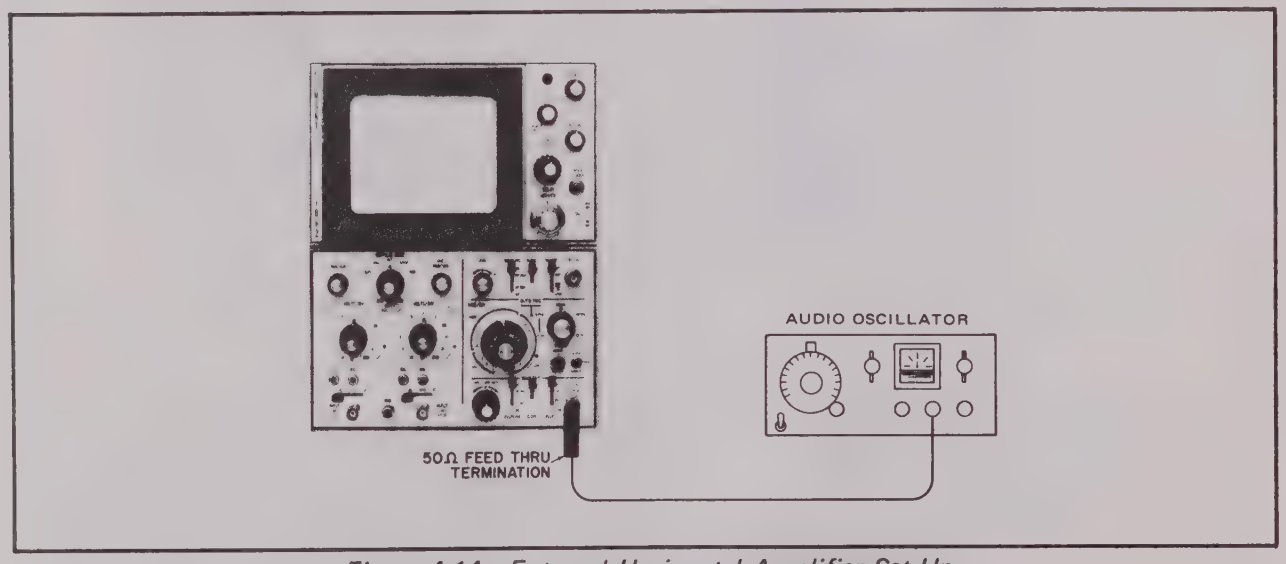


Figure 4-14. External Horizontal Amplifier Set-Up

4-16. EXTERNAL Z AXIS

Specification: 2v produces trace blanking at normal intensity.
risetime is 70 nsec.

4-16a. Connect as in Figure 4-15.

4-16b. Set 1062 controls:
SOURCE (23) – EXT
HOR MODE (29) – NORM
TIME/DIV (27A) – 0.1 μsec/div
VERT MODE (9) – CH 1

4-16c. Set pulse from pulse generator to be –2v high and 70 nsec wide. Observe that trace blanking occurs with normal intensity.

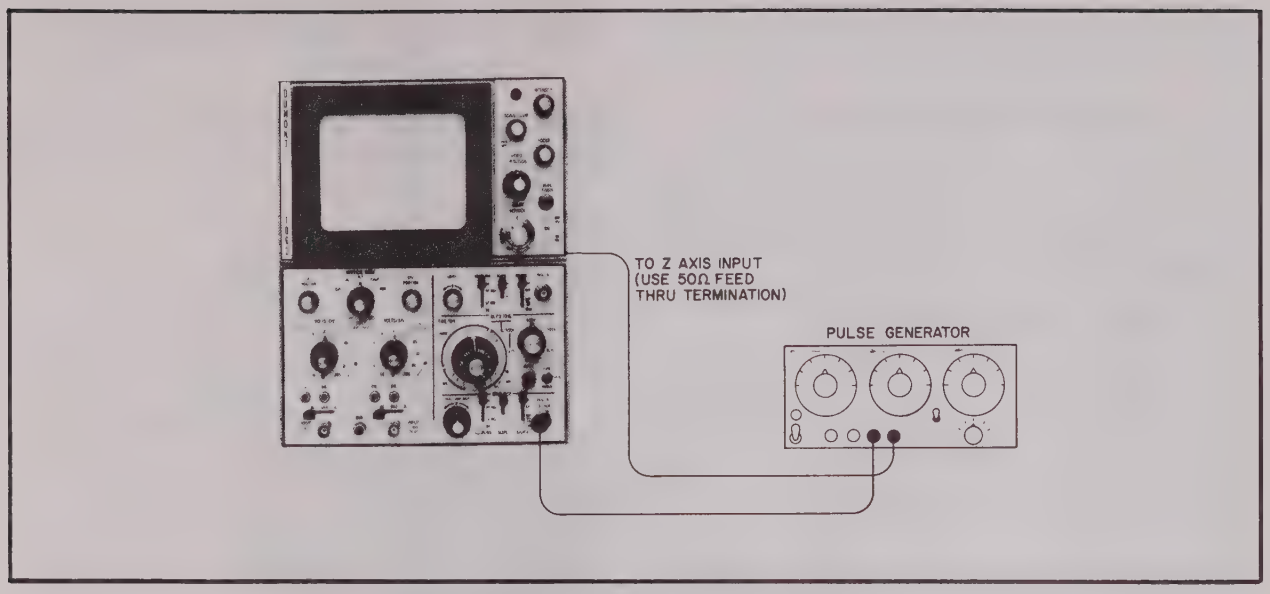


Figure 4-15. External Z Axis Set-Up

4-17. ADJUSTMENT AND CALIBRATION PROCEDURES

4-17a. Paragraphs 4-18 through 4-19 outline the procedure necessary to calibrate the controls and adjustments available on the front and rear panels.

4-17b. Paragraphs 4-20 through 4-23 outline the procedures necessary to calibrate the 1062 internally.

4-18. FRONT PANEL ADJUSTMENTS

4-18a. Set front panel control to:
AC-GND-DC (5) (14) – DC
VOLTS/DIV (6) (12) – 0.1
VERNIER (7) (13) – CAL
VERTICAL MODE (9) – CH 2 or CH 1
TRIG MODE (10) – DSPLY
HORIZ MODE (29) – NORM
SWEEP MODE (25) – AUTO
TIME/DIV (27A) – 0.2 msec/div
COUPLING (21) – AC
SLOPE (22) – +
SOURCE (23) – INT
X10 GAIN (37) – push in
POS (8) (11) – center trace on CRT

4-18b. Turn VERNIER (7) (13) from the CAL position to the maximum CCW position. Note the position of the trace and return the VERNIER (7) (13) to the CAL position. Adjust the BAL (4) (17) control until the trace returns to the position noted above. Repeat this until no trace displacement is observable when the VERNIER (7) (13) is turned from the CAL position to the full CCW position.

4-18c. Connect the 600 mv CALIBRATOR (42) to the Channel INPUT (1) (18) being calibrated. Adjust CAL (3) (16) for 6 cm of deflection.

4-19. REAR PANEL ADJUSTMENTS

4-19a. Set front panel controls as in Paragraph 4-18a.

4-19b. Center trace on center graticule with POS (8) (11) control. Adjust TRACE ALIGN (49) until trace is parallel to graticule line.

4-19c. Position trace to upper-most graticule and adjust PATTERN ADJUST (48) until trace is straight without any bowing. Set HORIZONTAL MODE (29) to EXT HOR, SOURCE (23) to EXT and connect INPUT (1) (18) to 60 mv CALIBRATOR (43). Adjust HORIZONTAL POSITION (36) so that trace is at the last graticule. Readjust PATTERN ADJUST (48) to eliminate bowing. Repeat all of Paragraph 4-19c to compromise between the horizontal-vertical pattern to give the most rectangular pattern.

4-19d. Disconnect calibrator, set AC-GND-DC (5) (14) to GND, and set HORIZONTAL MODE (29) to EXT HOR. Adjust INTEN (39) until the spot on the CRT is very dim. Adjust ASTIG (47) and FOCUS (38) until the spot is as small and round as possible.

4-19e. Turn INTENSITY (39) full CCW and adjust INTEN LIMIT (46) until spot just disappears.

4-20. INSTRUMENT COVER REMOVAL

4-20a. To remove instrument covers, remove the 4 phillips-head screws on each side of the scope. The bottom cover can be removed by removing the 4 phillips-head screws in the bottom cover.

4-21. POWER SUPPLY ADJUSTMENT

4-21a. With the covers removed, remove the 4 phillips-head screws in the corners of the lower back panel, pull down heat sink, and connect as in Figure 4-16.

4-21b. Adjust A5R1 to give +15.00 ± .02 volts.

4-21c. Connect Voltmeter to −15 volts on A5 and verify a voltage between −14.85 and −15.15 volts. Connect Voltmeter to +100 volts on A5 and verify a voltage between +98 and +102 volts.

4-21d. Connect a Dumont 1050 to each supply in succession, (+15, −15, & +100) and verify less than 2mV p-p of ripple.

4-21e. Connect voltmeter to +130V on A5 and verify a voltage between +125 and +135V.
NOTE: LINE VOLTAGE MUST BE 115VAC WHEN MAKING THIS MEASUREMENT.

4-21f. Disconnect all test equipment and mount power supply heat sink back on 1062 with the 4 phillips-head screws.

4-21g. Remove 2 phillips-head screws on H.V. cover and rotate out H.V. regulator assembly A12A6. Remove 4 phillips-head screws on upper rear panel and rotate out. See Figure 4-17.

4-21h. Connect H.V. Voltmeter to pin #7 of the CRT socket. Adjust A12A6R1 to give a reading of −1150 volts. See Fig. 4-17.

4-21i. Turn FOCUS (38) full CW or CCW to defocus trace and set HORIZONTAL MODE (29) to EXT HOR. Vary INTENSITY (39) through its full range and verify that the voltage reading on the H.V. Voltmeter (−1150) does not vary.

4-21j. Disconnect all test equipment and mount upper rear panel and H.V. cover back on 1062 with the 4 and 2 phillips-head screws respectively.

4-22. TRIGGER, SWEEP & HORIZONTAL ADJUSTMENTS

4-22a. With covers removed, as described in Paragraph 4-20a., set front panel controls:

INTENSITY (39) – CCW
AC-GND-DC (5) – DC
VOLTS/DIV (6) – 2
VERNIER (7) – CAL
VERTICAL MODE (9) – CH1
TRIG MODE (10) – DSPLY
TIME/DIV (27A) (27B) – 1 msec/div
VERNIER (28) – CAL
HORIZONTAL MODE (29) – EXT HOR
SWEEP MODE (25) – SINGLE
COUPLING (21) (33) – AC
SLOPE (22) (32) – +
SOURCE (23) (31) – EXT
LEVEL (19) (34) – set to "0"
X10 GAIN (37) –push in

4-22b. Connect DVM between center wiper of LEVEL (19) control and chassis ground.

NOTE: Center arm of LEVEL (19) control can be reached by connecting to main sweep board at wire 958 (A1R18).

Adjust LEVEL (19) to give 0±.05V. Connect 600 mV calibrator to CH 1 in (1), set SWEEP MODE (25) to Auto, and adjust VOLTS/DIV (6) and VERNIER (7) to give 0.3 cm of vertical deflection. If trace is not synchronized, adjust A1R1 to give a synchronized trace. Reset SWEEP MODE (25) to SINGLE, VOLTS/DIV (6) to 2 and VERNIER (7) to CAL.

4-22c. Connect DVM between case of A1Q19 and chassis ground. Adjust A1R2 for −0.15 volts.

4-22d. Connect DVM between A2TP1 and chassis ground. Adjust A2R6 to give 0.65 ± .01 volts.

4-22e. Connect DVM between case of A2Q17 and chassis ground. Adjust A2R82 to −0.15 volts. Disconnect DVM.

4-22f. Connect *BALANCED* DVM between collector of A3Q7 and A3Q10 and adjust HOR POS (36) (37) until there is less than 0.5 volts difference. DO NOT RE-ADJUST HOR POS (36) (37) UNTIL AFTER PARA. 4-22h.

4-22g. Increase INTENSITY (39) *VERY SLOWLY* until a dim spot appears on the CRT. Verify that the spot is within a region of ±0.5 cm from the center vertical gratical line.

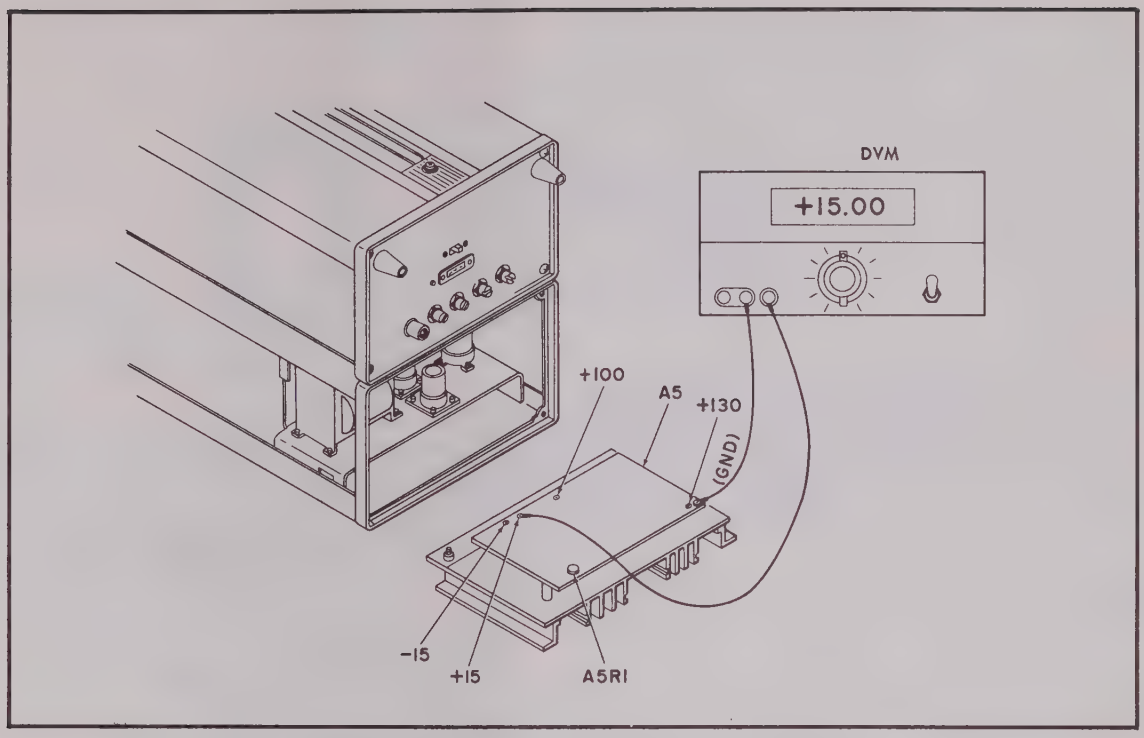


Figure 4-16. L.V. Power Supply Adjustments

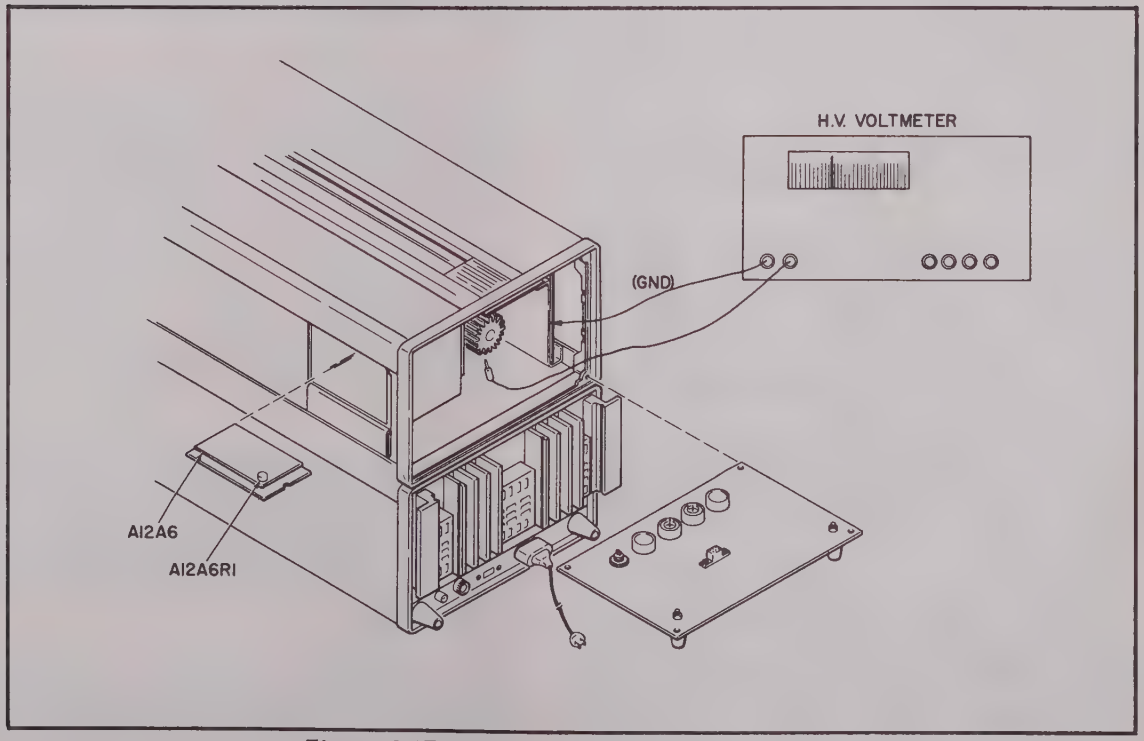


Figure 4-17. H.V. Power Supply Adjustments

4-22h. Connect DVM between the collector of A3Q7 and chassis ground and adjust A3R12 for a +50±0.2 volt reading. Disconnect DVM.

4-22i. Pull X10 GAIN (37) and set spot precisely on center graticule line with HORIZONTAL POSITION (36) (37) controls. Without disturbing the setting of the controls, push in X10 GAIN (37). Adjust A3R24 to re-position spot precisely on center graticule. Repeat this until no shift in spot is noticed when going from the X1 to the X10 gain mode.

4-22j. Set controls to:
SWEEP MODE (25) – AUTO
HORIZONTAL MODE (29) – NORM
INTENSITY (39) - as desired
SOURCE (23) (31) – INT
X10 GAIN (37) – push in

4-22k. Connect time mark generator to CH1 INPUT (1). Set time mark generator to 1 msec and adjust LEVEL (19) to synchronize trace. Set SWEEP MODE (25) to TRIG.

4-22l. Adjust A3R22 to give approximately 10.5 cm of sweep length.

4-22m. Adjust A1R3 to give a time mark on every major vertical graticule line.

4-22n. Pull X10 GAIN (37) and set time mark generator to 100 nsec. Adjust A3R16 to give a time mark on every major vertical graticule line.

4-22o. Set TIME/DIV (27A) (27B) to 1 μsec. Adjust A1C1 to give a time mark on every major Vertical graticule line.

4-22p. Set TIME/DIV (27A) (27B) to 0.1 μsec/div and pull X10 GAIN (37). Set time mark generator to give a 50 MHz signal. Adjust A3C9 to give one full cycle of signal at the middle of 2 cm of deflection.

4-22q. Alternately adjust A3C9, A3C8, and A3C10 to give the picture below in Figure 4-18.
NOTE: This adjustment needs to be calibrated over only the middle 8 cm, and is a compromise between absolute accuracy at the middle 2 cm and linearity at the beginning and end of sweep.

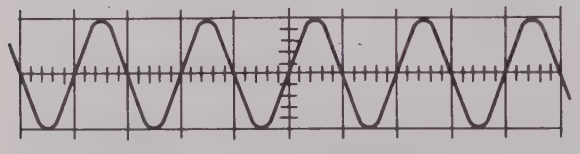


Figure 4-18. 1062 CRT Display

4-22r. Set controls to:
X10 GAIN (37) – push in
TIME/DIV (27A) (27B) – 1 msec/div
DELAY VERNIER (35) – 0.5
HORIZ MODE (29) – INTEN
HOR POS (36) (37) – Sweep starts at 1st Vertical graticule line.

4-22s. Set time mark generator 1 msec. Adjust A2R24 so that intensified portion of trace starts 0.5 cm from the start of main sweep. Turn DELAY VERNIER (35) CCW and verify a reading on the dial of 0.5. Adjust to 0.5 if reading is not 0.5.
NOTE: IF THERE IS NO INTENSIFIED PORTION, ADJUSTING A2R24 SHOULD CAUSE THE INTENSIFIED PORTION TO APPEAR. ALSO A2R85 CAN BE ADJUSTED TO DESIRED INTENSIFIED BRIGHTNESS RATIO.

4-22t. Set DELAY VERNIER (35) to 9.00 and adjust A2R25 until trace starts 9 cm from the start of main sweep.

4-22u. Set controls to:
TIME/DIV (27A) – 2msec/div
TIME/DIV (27B) – 1msec/div
VERNIER (28) – CAL
HORIZONTAL MODE (29) – DLYD

4-22v. With time mark generator set to 1 msec, adjust A2R76 to give a time mark on each major Vertical graticule line.

4-22w. Set TIME/DIV (27A) to 2 μsec/div and TIME/DIV (27B) to 1 μsec/div. Set time mark generator to 1 μsec. Adjust A2C32 to give a time mark on each major Vertical graticule line.

4-22x. Set controls to:
SWEEP MODE (25) – AUTO
HORIZ MODE (29) – NORM
TIME/DIV (27A) (27B) – 1 μsec/div
VOLT/DIV (6) – 0.5

4-22y. Connect CH1 INPUT (1) through a X10 HF probe to the collector of A3Q16. See Fig. 4-19. Adjust INTENSITY (39) to give 5 cm of deflection. Adjust A3C22 and A3C23 for the fastest rise time consistent with a flat top and less than 2% overshoot. The rise time should be approximately 70 nsec.

4-22z. At this time, the entire sweep and horizontal sections are adjusted. In order to perform a complete checkout of the entire trigger, sweep and horizontal system, refer to the performance checks in paragraphs 4-5 through 4-16.

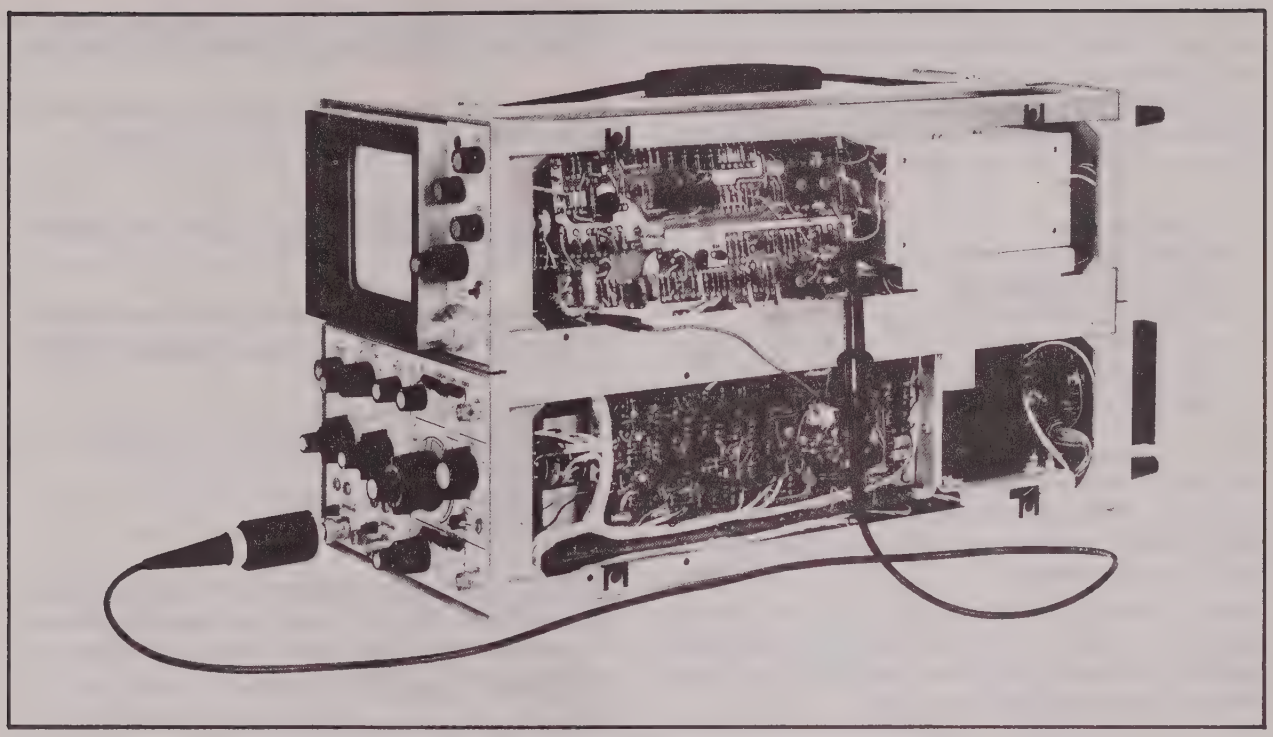


Figure 4-19. Un-Blanking Amplifier Adjustment

4-23. VERTICAL AMPLIFIER ADJUSTMENTS

4-23a. With outer covers removed, set controls to:
AC-GND-DC (1) (18) – DC
VOLTS/DIV (6) (12) – .01
VERNIER (7) (13) – CAL
VERT MODE (9) – CH2
TRIG MODE (10) – DSPLY
HOR MODE (29) – NORM
SWEEP MODE (25) – AUTO
COUPLING (21) – DC
SLOPE (22) – +
SOURCE (23) – INT
TIME/DIV (27A) (27B) – 1 msec/div
VERNIER (28) – CAL
X10 GAIN (37) – push in
POSITION (11) – Center trace on CRT

4-23b. Connect the Simpson 260, or equivalent, between Junction of A7R9, A7R20 and chassis gnd and set range to 2.5 vdc.

4-23c. Set BAL (17) so that the trace is approximately in the middle of the CRT. Pull INVERT (13) and adjust BAL (17) until no trace shift is noted when INVERT (13) is pulled.

4-23d. Adjust A7R1 for zero volts on the voltmeter.

4-23e. Set VERT MODE (9) to CH1.

4-23f. Repeat step 4-23c. through 4-23d. using the Channel 1 controls BAL (4), & INVERT (7), instead of the corresponding Channel 2 controls.

4-23g. Adjust A10R54 for zero volts on the voltmeter. Disconnect the voltmeter from the scope.

4-23h. Connect 600 mv CALIBRATOR (42) to CH1 INPUT (1) and set VOLT/DIV (6) to 0.1. Adjust CAL (3) for precisely 6 cm of deflection.

4-23i. Repeat step 4-23h. with calibrator connected to CH2 INPUT (18), VERT MODE (9) in CH2 and adjusting CAL (16).

4-23j. Set controls to:
VERT MODE (9) – CH1
VOLTS/DIV (6) – 0.1

4-23k. Connect oscillator to CH1 INPUT (1), set frequency to 1 KHz and adjust level to give 8 cm of deflection. Set VOLTS/DIV (6) to .05 and CH1 POSITION (8) full CW. Adjust A8R3 until the negative peaks of the sine wave are 2

cm above the center graticule. From this starting point, adjust the CH1 POSITION (8) control between the fully CW and CCW position and adjust A8R3 until the positive peaks with the POSITION (8) fully CCW are the same distance below the center graticule as the negative peaks with the POSITION (8) fully CW are above the center graticule.

4-23l. Set controls to:
AC-GND-DC (5) (14) – DC
VOLTS/DIV (6) (13) – 0.1
VERNIER (7) (13) – CAL
VERT MODE (9) – CH1
TRIG MODE (10) – DSPLY
TIME/DIV (27A) – 1 μsec/div

4-23m. Connect the square wave generator through a 50 ohm feed-thru termination to CH1 INPUT (1). Set the level for 8 cm of deflection and the frequency to 1 MHz. Adjust A8C9 for a flat-topped square wave. Set A10R40 & A10R101 to mid-range.

4-23n. Connect pulser through a 50 ohm feedthru termination to CH1 INPUT (1) and set TIME/DIV (27A) to 0.1 μsec/div. Set pulser to 0.5 V and adjust A8C20 to minimize delay line reflections. See Figure 4-20.

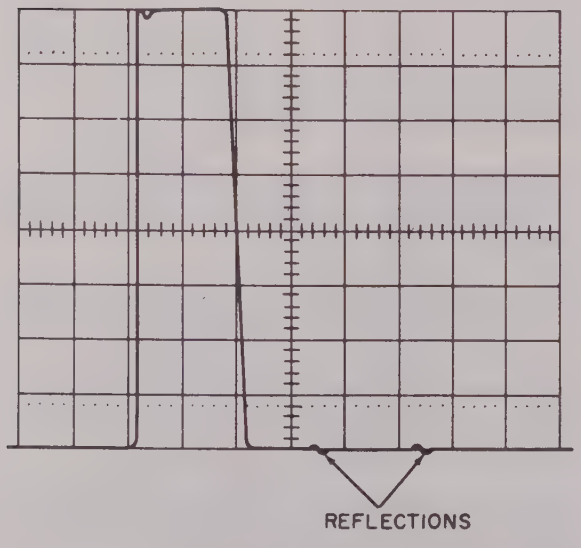


Figure 4-20. 1062 CRT Display

4-23o. Adjust A8C17 for a flat top on the pulse.

4-23p. Adjust A8C21 for minimum peaking and set A10C36 approx to its mid-range.

4-23q. At this time alternately adjust A8C8, A8R17, and A8C21 for fastest risetime with approx 0.25 cm of ringing and overshoot.

4-23r. Pull horizontal X10 GAIN (37) and note a rise time of less than 5.8 nsec. Push in horizontal X10 GAIN (37).

4-23s. Connect pulser to CH2 INPUT (18), VERT MODE (9) to CH 2.

4-23t. Adjust A10C37 for fastest rise time with minimum overshoot.

4-23u. Pull horizontal X10 GAIN (37) and note a rise time of less than 5.8 nsec. Push in horizontal X10 GAIN (37).

4-23v. Set controls to:
VERT MODE (9) – CH1
AC-GND-DC (5) – DC
VOLTS/DIV (6) – .005
VERNIER (7) – CAL

NOTE: The following paragraphs calibrate the attenuators; therefore, table 4-5 lists the capacitor number and the corresponding number code identification which appears on the Attenuator P.C. assembly A4A9.

TABLE 4-5

Capacitor Number	Ident Code
A4A9C11	1
A4A9C3	3
A4A9C5	5
A4A15C7	7
A4A9C2	2
A4A9C4	4
A4C6	6
A4A15C9	9
A4A15C11	11
A4A9C8	8
A4A9C10	10

4-23w. Connect L-C meter and adjust CH 1 attenuator A4A9C11 to give a 24 pf reading.

4-23x. Connect a 10 KHz square wave through a 10 dB pad to CH 1 INPUT (1), set VOLTS/DIV (6) to .01, and adjust CH 1 attenuator A4A9C3 for a flat-topped square wave. Adjust A10R40 to remove HF Peak from square wave.

4-23u. Set VOLTS/DIV (6) to .02 and adjust CH 1 attenuator A4A1SC1 for a flat-topped square wave.

4-23z. Set VOLTS/DIV (6) to .05 and adjust CH 1 attenuator A4A15C7 for a flat-topped square wave.

4-23aa. Set VOLTS/DIV (6) to 0.1 and adjust CH 1 Attenuator A4A9C2 for a flat-topped square wave.

4-23bb. Set VOLTS/DIV (6) to 0.2 and adjust CH 1 Attenuator A4A9C4 for a flat-topped square wave.

4-23cc. Set VOLTS/DIV (6) to 0.5, connect 10 KHz square wave to CH 1 INPUT (1) and adjust A4A15C9 for a flat-topped square wave.

4-23dd. Set VOLTS/DIV (6) to 5 and adjust A4A15C11 for a flat-topped square wave.

4-23ee. Set VOLTS/DIV (6) to .05 and adjust CH 1 Attenuator A4A9C6 for a 24 pf reading.

4-23ff. Set VOLTS/DIV (6) to 0.5 and connect L-C meter to CH 1 INPUT (1). Adjust A419C8 for a 24 pf reading.

4-23gg. Set VOLTS/DIV (6) to 5 and adjust A4A9C10 for a 24 pf reading.

4-23hh. Repeat steps 4-23w thru 4-23gg for Channel 2, adjusting A10R101 in step 4-23x.

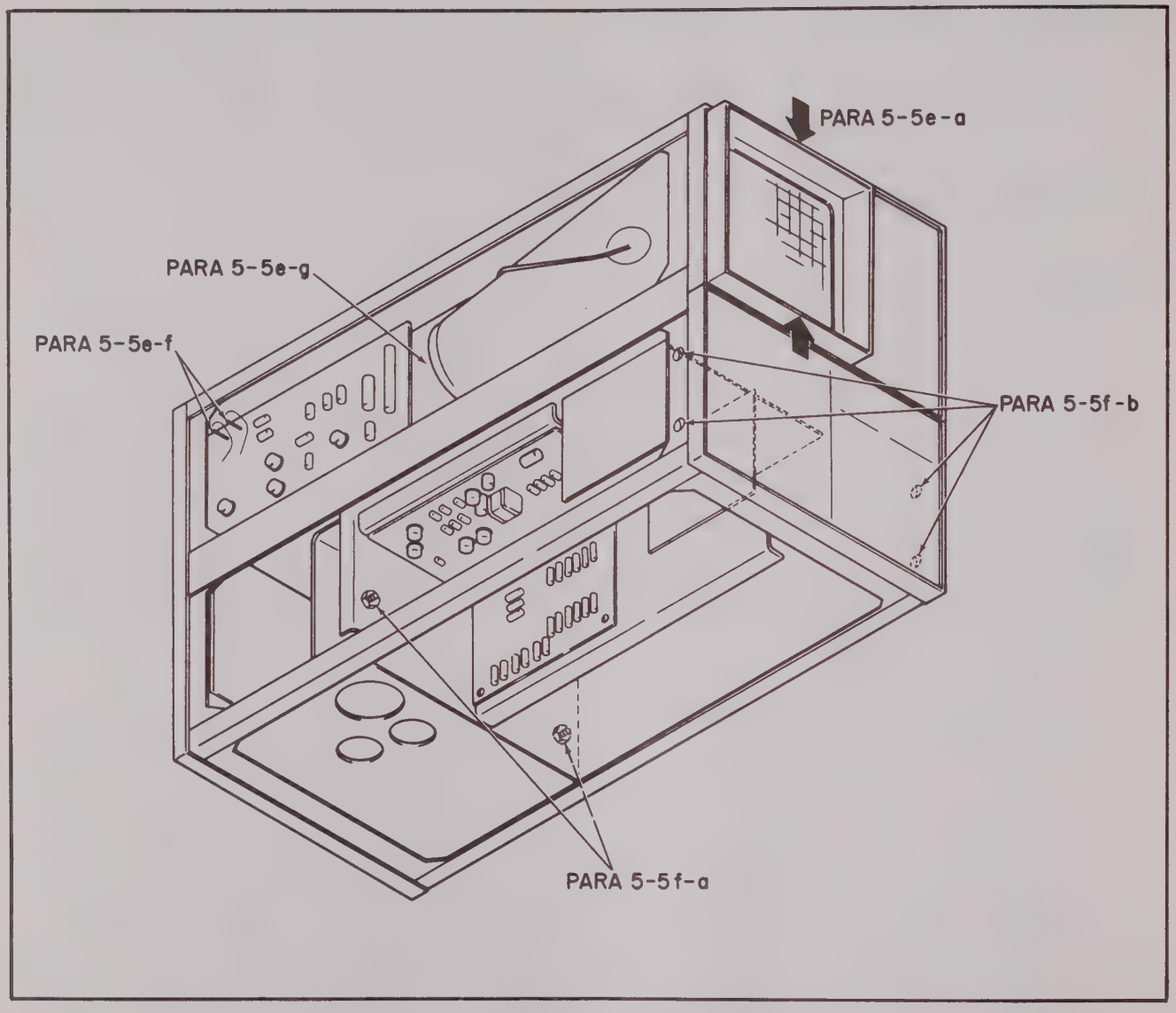


Figure 5-0. Repair and Replacement Guide

Section 5

Parts List and Circuit Diagrams

5-1. INTRODUCTION

5-1a. This section provides schematics, replaceable parts lists and other maintenance and trouble-shooting information.

5-2. SCHEMATIC DIAGRAMS

5-2a. The schematic diagrams show all electrical components which are used in the 1062. Components which appear in the shaded areas are located on the printed circuit board which is identified in the upper left hand corner of the shaded area. Any component not located in a shaded area is either hand wired to the chassis or located on the front or rear panel. Front panel controls are identified by a solid rectangle around the name, and rear panel controls are identified by a dashed rectangle around the name.

5-3. COMPONENT LOCATION

5-3a. Components which are identified on the schematic can be located on the printed circuit board by referring to the layout which appears on the page opposite the schematic. From here, the stock number can be found by referring to the replaceable parts list preceding the schematic.

5-4. TROUBLE SHOOTING

5-4a. Before attempting to trouble-shoot and/or repair the 1062, be sure that there is a thorough understanding as to how the instrument functions. Figures 2-3 through 2-6 and Paragraphs 4-5 through 4-23 outline the operation and adjustment procedures. If, after performing these tests, there still is a malfunction, proceed to trouble-shoot the instrument.

5-4b. Key wave forms (identified by a number and a triangle) are shown on the schematics and can be used as a troubleshooting aid.

5-5. REPAIR AND REPLACEMENT

5-5a. For all of Paragraph 5-5, refer to Figure 5-0.

5-5b. This section indicates how main assembly areas should be removed and/or repaired.

5-5c. Printed circuit repairs and replacements must be handled with great caution, as it is possible to permanently damage the fibreglass laminations. Any components found defective should have their leads clipped, leaving just the lead soldered to the board. Using a soldering iron of less than 50 watts, apply heat to the lead and pull steadily on it with a set of long-nosed pliers, and clean the hole out by extracting the excess solder with some sort of suction device. Insert the new component in such a way that the leads do not protrude out of the other side of the board by more than 1/16". Apply heat and solder to the lead. IF USING AN ACID FLUX, BE SURE TO WASH CLEAN AS THE FLUX WILL DAMAGE THE COMPONENT AND THE PRINTED CIRCUIT BOARD. When the leads of the component are not available; e.g., a board mounting pot, heat the leads alternately from the back side and apply a steady pull on the component.

5-5d. ATTENUATOR REMOVAL

The vertical attenuators can be removed for service by:

a. Disconnect all wires plugged onto the Attenuator.

b. Unsolder A4A15R1 from the AC-GND-DC (5) (14) control.

c. Remove the knobs on the VERNIER (7) (13) and VOLTS/DIV (6) (12) controls. (Loosen set screws.

d. Remove the hex-nut connected to the shaft of the VOLTS/DIV (6) (12) controls.

e. Remove plastic support located between CH 1 and CH 2 attenuators by pulling back on it.

f. Pull back and up slightly on the rear of the attenuator.

CAUTION

The grounding, spring fingers on the attenuator switch are very fragile. Handle with care.

To replace the attenuator, reverse the order of the above steps.

5-5e. CRT REMOVAL

The CRT is removed by:

a. Remove plastic insert in bezel by applying a force from the top and bottom.

b. Remove the four screws holding the bezel casting and pull bezel casting forward.

c. Remove the side covers.

d. Lower upper rear panel by removing the four phillips-head screws located in the corners of the rear panel.

e. Pull connector from the rear of the CRT.

f. Disconnect the two wires plugged onto the upper left corner of the Vertical Output Amplifier Assy, A8. These wires are the trace rotation coil wires and must feed through the hole located in the bottom of the mu-metal CRT shield in the deflection plate area.

g. Disconnect five leads connected to the side of the CRT.

h. Disconnect post-accelerator lead.

CAUTION

This lead maintains a certain residual charge. Carefully lift edge of insulator and short terminal to ground with a screwdriver before removing.

i. Loosen screw in clamp holding the CRT. This screw can be reached from just above the Vertical Output Amplifier A8.

j. The CRT is now disconnected. Apply a steady push to the rear of the CRT and at the same time, guide the trace rotate wires. When the CRT is approximately 2 inches out, pull it the rest of the way out from the front. Be careful of the neck pins when extracting the CRT.

5-5f. FUNCTION CHASSIS

The entire lower section, including assemblies A1, A2, A7, A10, and A4 can be pulled forward approximately 4 inches to allow servicing of hard-to-reach areas such as the front panel controls. This is done by:

a. Remove the two nuts located on each side and to the rear of the function chassis.

b. Remove the four No. 6 flat-head screws located in the side of the front lower support casting.

c. Pull slowly forward on this lower unit.

CAUTION

The VERTICAL MODE (9) and HORIZONTAL MODE (29) controls are located at the edge of this function chassis. Caution must be taken when pulling the function chassis not to catch these controls on the casting.

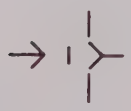
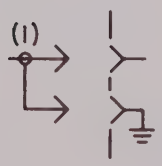
5-5g. TIMING SWITCH

The time switch is accessible by removing the screws which fasten the Delay Sweep Assembly A2 and swinging it away.

5-6. SCHEMATIC SYMBOLS

5-6a. Table 5-1 indicates the key to symbols used on the schematics.

Table 5-1

	main signal path
	feedback signal path
	signal test point
P/O	part of
	front panel control
	rear panel control
	screwdriver adjust
MS	mounting screw
	connecting pin number as indicated on PC layout
	color code of sleeving
(902)	wire color code

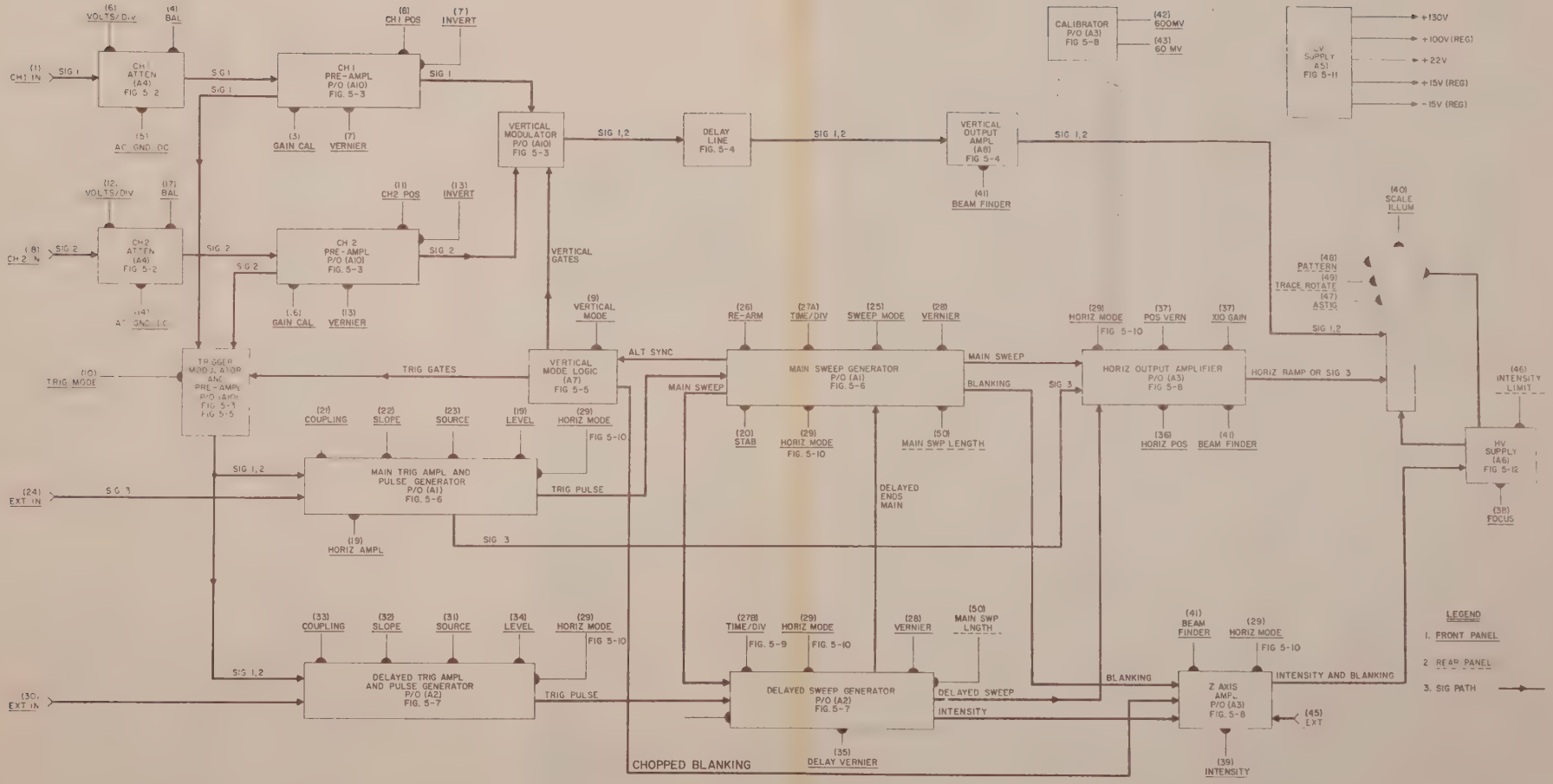
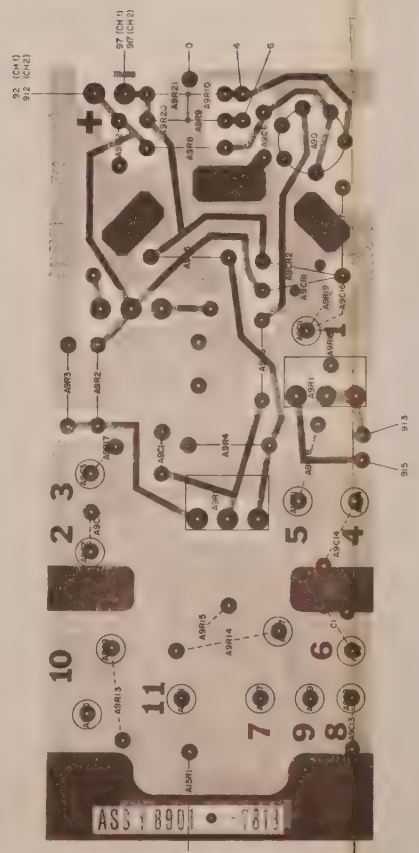


FIG. 5-1
BLOCK DIAGRAM

TABLE 5-2

Reference Designation	Stock Number	Description
A4	8901-7888	Attenuator Assembly
A4C1	0327-4020	Cap, Fxd, Cer, 10 pf
A4C6	0319-1254	Cap, Var, 0.7-3 pf
A4R1	–	(See table 5-3)
A4R2	0235-4720	Res, Fxd, Comp, 3K, 1/4W
A4A9	8901-7881	Atten printed circuit assy
A4A9C1	0319-1050	Cap, Fxd, Cer, 0.02 μf
A4A9C2,3	0319-1254	Cap, Var, 0.7-3 pf
A4A9C4	0319-1264	Cap, Var, 0.7-3 pf
A4A9C6	0328-1420	Cap, Fxd, Cer, 0.47 μf
A4A9C7	0313-9730	Cap, Fxd, Mica, 100 pf
A4A9C8	0319-1263	Cap, Var, 0.7-3 pf
A4A9C9	0326-3070	Cap, Fxd, Mica, 1000 pf
A4A9C10	0319-1254	Cap, Var, 0.7-3 pf
A4A9C11	0319-1266	Cap, Var, 0.7-3 pf
A4A9C12	0319-1050	Cap, Fxd, Cer, 0.02 μf
A4A9C13	0319-7440	Cap, Fxd, Cer, 12 pf
A4A9C14	0328-1400	Cap, Fxd, Cer, 5.5 pf
A4A9C15	0327-4040	Cap, Fxd, Cer, 2.2 pf
A4A9C16	0328-1230	Cap, Fxd, Cer, 0.002 μf
A4A9CR1,2	2601-2320	Dio, Si
A4A9Q1	2601-0380	Trans, Field Effect
A4A9R1	0107-3531	Res, Var, Film, 1K
A4A9R2	0235-5020	Res, Fxd, Comp, 51K, 1/4W
A4A9R3,4	0235-4620	Res, Fxd, Comp, 1K, 1/4W
A4A9R5	0235-5020	Res, Fxd, Comp, 51K, 1/4W
A4A9R6,7	0235-4380	Res, Fxd, Comp, 100, 1/4W
A4A9R8	0235-4550	Res, Fxd, Comp, 510, 1/4W
A4A9R9,10	0238-8850	Res, Fxd, Film 1K, 1/8W
A4A9R11	–	(See table 5-3)
A4A9R13	0238-8850	Res, Fxd, MF, 1.00K, 1/8W
A4A9R14	0238-8910	Res, Fxd, MF, 10.1K, 1/8W
A4A9R15	0238-9740	Res, Fxd, Film 111K, 1/2%, 1/8W
A4A9R16	0238-9630	Res, Fxd, MF, 333K, 1/8W
A4A9R17,18	0238-8990	Res, Fxd, MF, 1M, 1/8W
A4A9R19	0203-1050	Res, Fxd, Comp, 240K, 1/2W
A4A9R20	0238-9680	Res, Fxd, Film 1.21K 1/8W
A4A9R21	0240-3380	Thermistor
A4A9S2	–	(See table 5-3)
	4003-1481	Printed Circuit Board
	5102-2730	Teflon receptacle
	5102-2760	Pin, cont, P.C.
A4A15	8901-7791	Attenuator Switch Assy.
A4A15C1	0327-3920	Cap, Var, 0.2-1.5 pf
A4A15C3	0319-7460	Cap, Fxd, Cer, 13 pf
A4A15C4	0327-4040	Cap, Fxd, Cer, 2.2 pf
A4A15C5	0319-7440	Cap, Fxd, Cer, 12 pf
A4A15C6	0328-3130	Cap, Fxd, Cer, 1.5 pf
A4A15C7,9,11	0327-3920	Cap, Var, 0.2-1.5 pf
A4A15R1	0235-4330	Res, Fxd, Comp, 62, 1/4W
A4A15R2	0235-4140	Res, Fxd, Comp, 10, 1/4W
A4A15R3	0238-9690	Res, Fxd, Film 900K, 1/2%, 1/8W
A4A15R4	0238-9700	Res, Fxd, Film 990K, 1/2%, 1/8W
A4A15R5	0238-9710	Res, Fxd, Film 999K, 1/4%, 1/8W
A4A15R6	0238-8940	Res, Fxd, MF, 500K, 1/8W
A4A15R7	0238-9620	Res, Fxd, MF, 750K, 1/8W
A4A15R8	0235-4250	Res, Fxd, Comp, 30, 1/4W
	0501-8652	Switch, Rotary
A13J1,2	0906-0120	Connector, BNC
A13C6,7	0328-1320	Cap, Fxd, Film, 0.056 μf
A13R17,18	0235-4140	Res, Fxd, Comp, 10, 1/4W
A13S6,7	0501-8671	Switch, Lever
A13CR2,3	2601-0710	Dio. LED



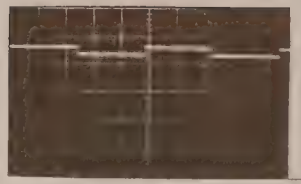
Waveforms (fig. 5-2)

When making the measurements to verify the waveforms below set the front panel controls to the initial settings listed below.

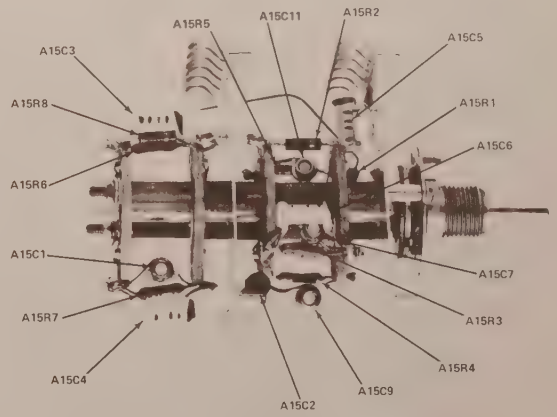
AC-GND-DC (5) (14)	— DC
VERNIER (7) (13)	— CAL
X10 GAIN (7) (13)	— push in
VERTICAL MODE (9)	— ALT
VOLTS/DIV (6) (12)	— .1
TRIG MODE (10)	— COMP
COUPLING (21) (33)	— AC
SLOPE (22) (32)	— +
SOURCE (23) (31)	— INT
SWEEP MODE (25)	— AUTO
HORIZ MODE (29)	— NORM
VERNIER (28)	— CAL
X10 GAIN (37)	— push in
MAIN SWEEP LENGTH (50)	— FULL

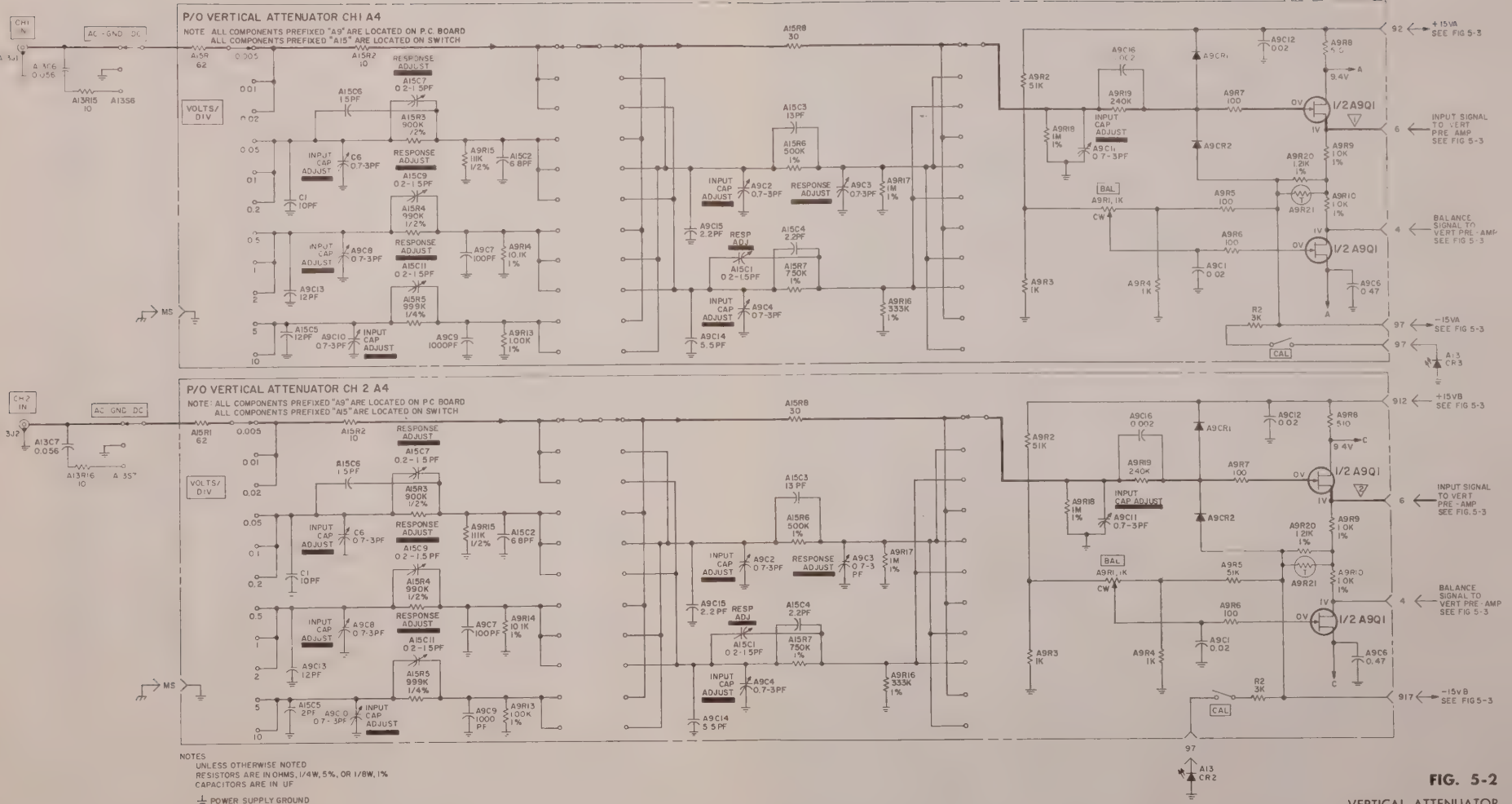
Connect CAL (42) to CH1 IN (1) and CH2 IN (18) and adjust LEVEL (19) for a stable trace on CRT. Trigger the test scope with the CAL (43) signal.

Voltages are measured with no signal connected, VERT MODE (10) set to Add, and position controls centered.



1 2
VERT: .2v/div — d-c coupled
HOR: .2msec/div





NOTES

UNLESS OTHERWISE NOTED
RESISTORS ARE IN OHMS, 1/4W, 5%, OR 1/8W, 1%
CAPACITORS ARE IN UF

⏚ POWER SUPPLY GROUND

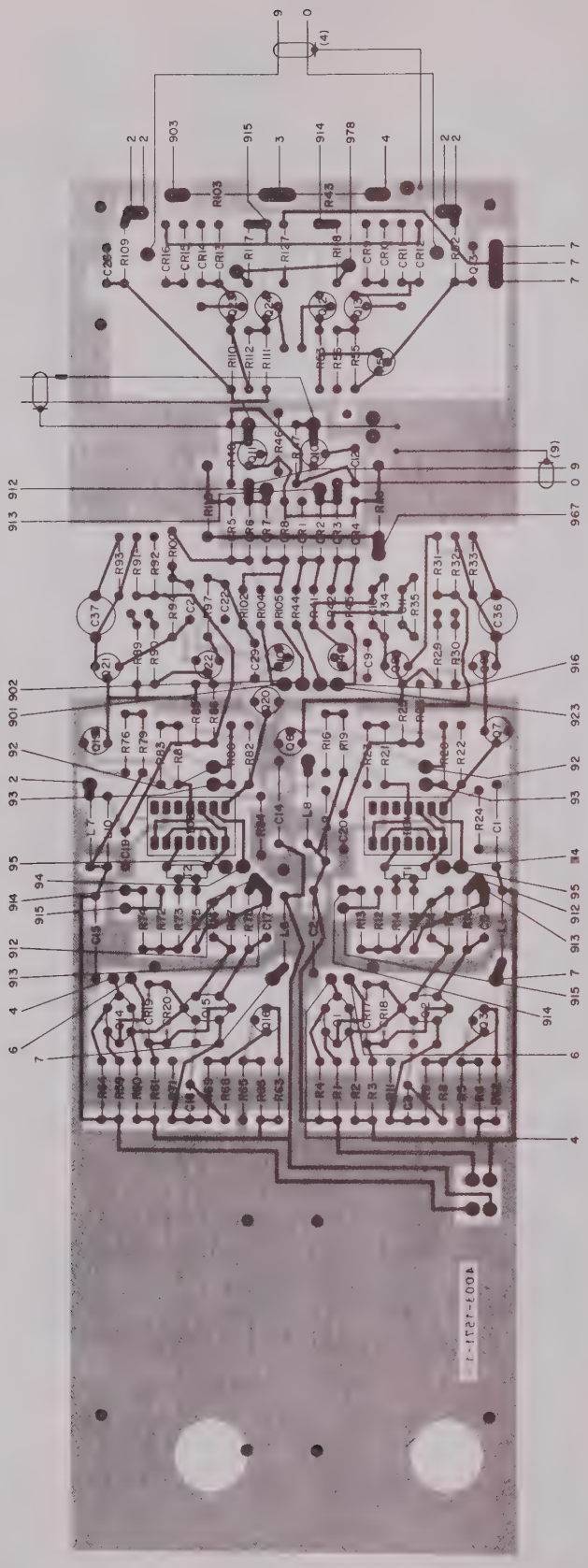
⏚ CHASSIS GROUND

FIG. 5-2

VERTICAL ATTENUATOR

TABLE 5-3

Reference Designation	Stock Number	Description
A10	8901-7788	Vertical Pre-amp Assy
A10C1,2	0328-0640	Cap, Fxd, Elect, 8 µf, 25 v
A10C3	0317-5100	Cap, Fxd, Mica, 20 pf
A10C4,5	0328-1410	Cap, Fxd, Cer, 0.001 µf
A10C9	0317-5150	Cap, Fxd, Mica, 33 pf
A10C10,11	0328-1410	Cap, Fxd, Cer, 0.001 µf
A10C12,13	0319-1050	Cap, Fxd, Cer, 0.02 µf
A10C14, 15	0328-0640	Cap, Fxd, Elect, 8 µf, 25 v
A10C16,17	0328-1410	Cap, Fxd, Cer, 0.001 µf
A10C18	0317-5100	Cap, Fxd, Mica, 20 pf
A10C19,20	0319-1050	Cap, Fxd, Cer, 0.02 µf
A10C21,22	0328-1410	Cap, Fxd, Cer, 0.001 µf
A10C26	0319-1050	Cap, Fxd, Cer, 0.02 µf
A10C29	0317-5150	Cap, Fxd, Mica, 33 pf
A10C36,37	0327-3610	Cap, Var, 5.5-18 pf
A10CR1-8	2600-3181	Matched set (8)
A10CR9-16	2600-3181	Matched set (8)
A10CR17-20	2600-6930	Dio, Si, FD-100
A10IC1,2	2601-0610	IC, CA3046
A10L1	2110-2500	Ind, Mld, 4.7 µH
A10L2-5	2110-1560	Bead, Ferrite
A10L6	2110-2500	Ind, Mld, 4.7 µH
A10L7,8	2110-2510	Ind, Mld, 47 µH
A10L9,10	2110-2500	Ind, Mld, 4.7 µH
A10Q1,2	2601-0250	Tstr, Dual, 2N3424
A10Q3	2601-0420	Tstr, Si, 2N3694
A10Q6,7	2600-3151	Matched pair
A10Q8,9	2600-3151	Matched pair
A10Q10-13	2601-0160	Tstr, Si, 2N4916
A10Q14,15	2601-0250	Tstr, Dual, 2N3424
A10Q16	2601-0420	Tstr, Si, 2N3694
A10Q19,20	2600-3151	Matched pair
A10Q21,22	2600-3151	Matched pair
A10Q23,24	2601-0160	Tstr, Si, 2N4916
A10R1	0235-4650	Res, Fxd, Comp, 1.5K, 1/4W
A10R2,3	0235-4730	Res, Fxd, Comp, 3.3K, 1/4W
A10R4	0235-4650	Res, Fxd, Comp, 1.5K, 1/4W
A10R5	0238-9430	Res, Fxd, MF, 909, 1/8W
A10R6	0238-9450	Res, Fxd, 2K, MF, 1/8W
A10R7	0235-4460	Res, Fxd, Comp, 220, 1/4W
A10R8,9	0238-8730	Res, Fxd, MF, 30.1, 1/8W
A10R10	0235-4460	Res, Fxd, Comp, 220, 1/4W
A10R12	0238-8820	Res, Fxd, MF, 301, 1/8W
A10R13	0235-4350	Res, Fxd, Comp, 75, 1/4W
A10R14,15	0238-8770	Res, Fxd, MF, 100, 1/8W
A10R16	0235-4680	Res, Fxd, Comp, 2K, 1/4W
A10R19	0238-9180	Res, Fxd, MF, 1.47K, 1/8W
A10R20	0238-9430	Res, Fxd, MF, 909, 1/8W
A10R21,22,23	0238-9210	Res, Fxd, MF, 261, 1/8W
A10R24	0238-9430	Res, Fxd, MF, 909, 1/8W
A10R25,26	0235-4620	Res, Fxd, Comp, 1K, 1/4W
A10R29,30	0235-4210	Res, Fxd, Comp, 20, 1/4W
A10R31,32	0328-9210	Res, Fxd, MF, 261, 1/8W
A10R33	0238-8770	Res, Fxd, MF, 100, 1/8W
A10R34,35	0235-4520	Res, Fxd, Comp, 390, 1/4W
A10R40	0109-6460	Res, Var, Film, 100K
A10R41,42	0203-8870	Res, Fxd, Comp, 100, 1/8W
A10R43	0203-3760	Res, Fxd, Comp, 15K, 1W
A10R44,45	0203-8880	Res, Fxd, Comp, 510, 1/8W
A10R46	0235-4550	Res, Fxd, Comp, 510, 1/4W
A10R47,48	0238-9250	Res, Fxd, MF, 93.1, 1/8W
A10R52	0235-4300	Res, Fxd, Comp, 47, 1/4W
A10R53	0238-9640	Res, Fxd, MF, 511, 1/8W
A10R54	0109-6430	Res, Var, Film, 200
A10R55	0238-9640	Res, Fxd, MF, 511, 1/8W
A10R56	0235-4300	Res, Fxd, Comp, 47, 1/4W
A10R59	0235-4650	Res, Fxd, Comp, 1.5K, 1/4W
A10R60, 61	0235-4730	Res, Fxd, Comp, 3.3K, 1/4W
A10R62,63	0238-9430	Res, Fxd, MF, 715, 1/8W
A10R64	0235-4650	Res, Fxd, Comp, 1.5K, 1/4W
A10R65	0238-9430	Res, Fxd, 909, 1/8W, MF
A10R66	0238-9450	Res, Fxd, MF, 2K, 1/8W
A10R67	0235-4460	Res, Fxd, Comp, 220, 1/4W
A10R68,69	0238-8730	Res, Fxd, MF, 30.1, 1/8W
A10R70	0235-4460	Res, Fxd, Comp, 220, 1/4W
A10R72	0238-8820	Res, Fxd, MF, 301, 1/8W
A10R73	0238-8770	Res, Fxd, MF, 100, 1/8W
A10R74	0235-4350	Res, Fxd, Comp, 75, 1/4W
A10R75	0238-8770	Res, Fxd, MF, 100, 1/8W
A10R76	0235-4680	Res, Fxd, Comp, 2K, 1/4W
A10R79	0238-9180	Res, Fxd, MF, 1.47K, 1/8W
A10R80	0238-9430	Res, Fxd, MF, 909, 1/8W
A10R81,82,83	0238-9210	Res, Fxd, MF, 261, 1/8W
A10R84	0238-9430	Res, Fxd, MF, 909, 1/8W
A10R85,86	0235-4620	Res, Fxd, Comp, 1K, 1/4W
A10R89,90	0235-4210	Res, Fxd, Comp, 20, 1/4W
A10R91,92	0238-9210	Res, Fxd, MF, 261, 1/8W
A10R93	0238-8770	Res, Fxd, MF, 100, 1/8W
A10R94	0235-4520	Res, Fxd, Comp, 390, 1/4W
A10R97	0235-4520	Res, Fxd, Comp, 390, 1/4W
A10R100	0203-8870	Res, Fxd, Comp, 100, 1/8W
A10R101	0109-6460	Res, Var, Film, 100K
A10R102	0203-8870	Res, Fxd, Comp, 100, 1/8W
A10R103	0203-3760	Res, Fxd, Comp, 15K, 1W
A10R104,105	0203-8880	Res, Fxd, Comp, 510, 1/8W
A10R109	0235-4300	Res, Fxd, Comp, 47, 1/4W
A10R110,111	0238-9570	Res, Fxd, MF, 619, 1/8W
A10R112	0235-4300	Res, Fxd, Comp, 47, 1/4W
A10R115,116	0238-9270	Res, Fxd, MF, 866, 1/4W
A10R117,118	0238-8880	Res, Fxd, MF, 3.01K, 1/8W
A10R127	0235-5130	Res, Fxd, Comp, 150K, 1/4W
A10T1,2	2101-9561	Ind. Assy.
	4003-1571	Printed Circuit Board
	5102-0150	Terminal Stud
	5102-2760	Pin, Contact
	5102-2790	Socket, Lead
A13R15,16	0107-3501	Res, Var, Comp, 5K
A4R1	0107-2938	Res, Var, 10K, w/Sw
A4A9R11	0107-3551	Res, Var, Film, 10K
A4A9S2	0503-2450	Sw, Toggle, DPDT
A4T1	2110-2580	Torroid, Ferrite



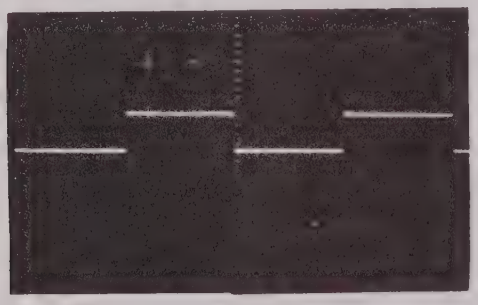
Waveforms (fig. 5-3)

When making the measurements to verify the waveforms below set the front panel controls to the initial settings listed below.

AC-GND-DC (5) (14)	— DC
VERNIER (7) (13)	— CAL
X10 GAIN (7) (13)	— push in
VERTICAL MODE (9)	— ALT
VOLTS/DIV (6) (12)	— .1
TRIG MODE (10)	— COMP
COUPLING (21) (33)	— AC
SLOPE (22) (32)	— +
SOURCE (23) (31)	— INT
SWEEP MODE (25)	— AUTO
HORIZ MODE (29)	— NORM
VERNIER (28)	— CAL
X10 GAIN (37)	— push in
MAIN SWEEP LENGTH (50)	— FULL

Connect CAL (42) to CH1 IN (1) and CH2 IN (18) and adjust LEVEL (19) for a stable trace on CRT. Trigger the test scope with the CAL (43) signal.

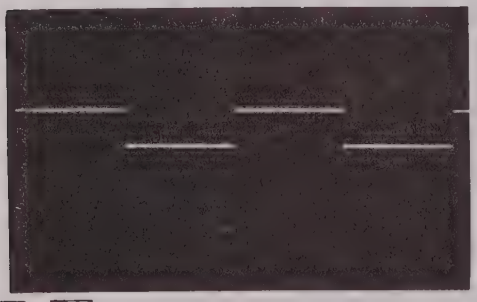
Voltages are measured with no signal connected, VERT MODE (10) set to Add, and position controls centered.



1 3

VERT: .2 v/div a-c coupled

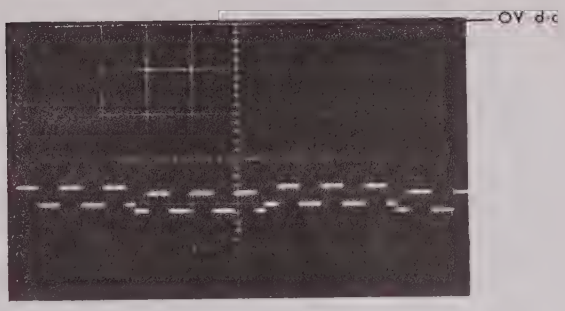
HOR: .2 msec/div



2 4

VERT: .2 v/div a-c coupled

HOR: .2 msec/div

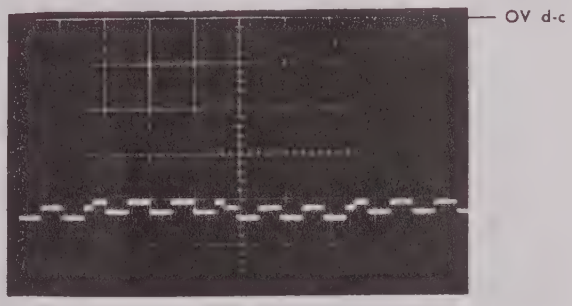


5

VERT: .2 v/div d-c coupled

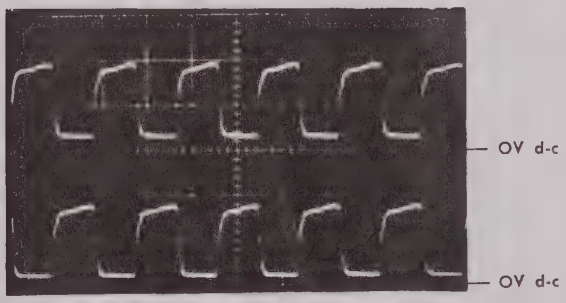
HOR: 1 msec/div

Adjust CH1 POS (8) and CH2 POS (11) until traces on CRT overlap



6

Conditions same as 5



7 (top) 8 (bot)

VERT: 1 v/div d-c coupled

HOR: 1 usec/cm

For this waveform set VERT MODE (9) to CHOP and trigger test scope internally.

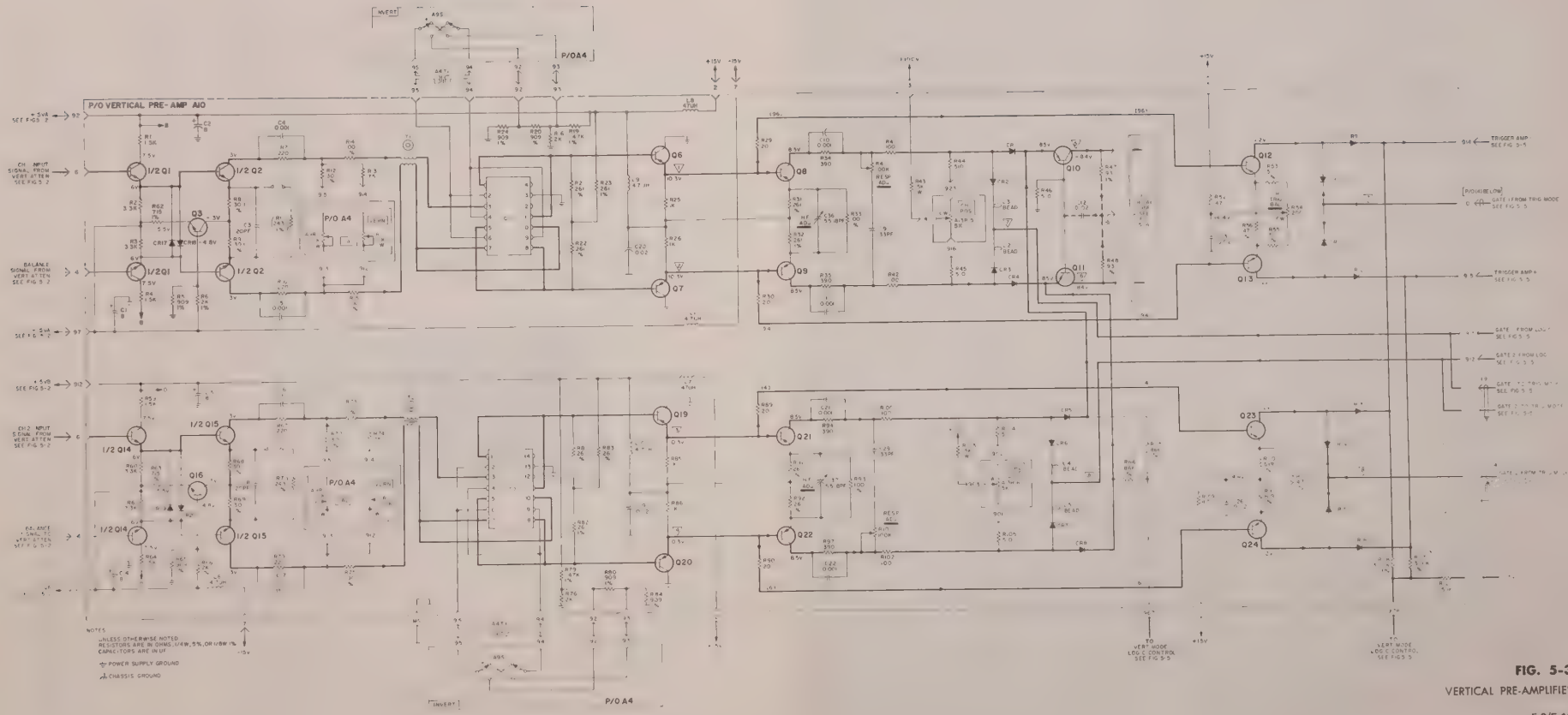
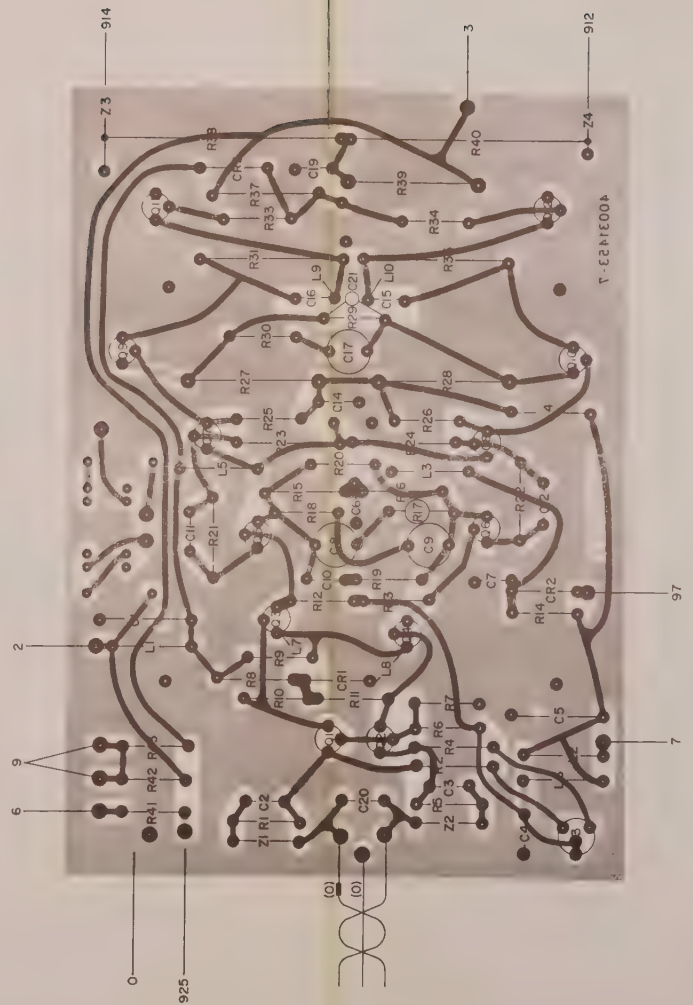


FIG. 5-3
VERTICAL PRE-AMPLIFIER

TABLE 5-4

Reference Designation	Stock Number	Description
A8	8901-7603	Vertical Output Amplifier Assy
A8C1	0328-0640	Cap, Fxd, Elect, 8 µf, 25 V
A8C2,3	0316-7240	Cap, Fxd, Cer, 6.8 pf
A8C4	0319-1050	Cap, Fxd, Cer, 0.02 µf
A8C5	0328-0640	Cap, Fxd, Elect, 8 µf, 25 V
A8C6,7	0319-1050	Cap, Fxd, Cer, 0.02 µf
A8C8	0327-3610	Cap, Var, 5.5–18 pf
A8C9	0327-3670	Cap, Var, 9–35 pf
A8C10	0317-5240	Cap, Fxd, Mica, 68 pf
A8C11,12	0328-1410	Cap, Fxd, Cer, .001
A8C14	0319-1050	Cap, Fxd, Cer, 0.02 µf
A8C15,16	0317-5750	Cap, Fxd, Mica 1000 pf
A8C17	0327-3670	Cap, Var, 9–35 pf
A8C19	0319-1050	Cap, Fxd, Cer, 0.02 µf
A8C20	0327-3600	Cap, Var, 2–8 pf
A8C21	0328-3140	Cap, Var, 6–22 pf
A8CR1	2601-3100	Dio, Zener, 1N746A
A8CR2	2600-6930	Dio, Si, FD-100
A8CR3	2601-3120	Dio, Zener, 1N967B
A8L1,2	2110-2510	Ind, Mld, 47 µH
A8L3-6	2110-2500	Ind, Mld, 4.7 µH
A8L7-10	2110-1560	Ind, Bead, Ferrite
A8Q1-8	2631-3490	Tstr, Si, 2N3563
A8Q9,10	2601-0520	Tstr, Si, 2N5109
A8Q11,12	2601-0530	Tstr, Si, 2N3866
A8R1	0238-8760	Res, Fxd, MF, 90.9, 1/8W
A8R2	0203-0390	Res, Fxd, Comp, 430, 1/2W
A8R3	0109-6510	Res, Var, MF, 100
A8R4	0203-0390	Res, Fxd, Comp, 430, 1/2W
A8R5	0238-8760	Res, Fxd, MF, 90.9, 1/8W
A8R6	0235-4710	Res, Fxd, Comp, 2.7K, 1/4W
A8R7	0235-4490	Res, Fxd, Comp, 300, 1/4W
A8R8	0203-0410	Res, Fxd, Comp, 510, 1/2W
A8R9	0235-4540	Res, Fxd, Comp, 470, 1/4W
A8R10,11	0238-8810	Res, Fxd, MF, 243, 1/8W
A8R12,13	0235-4730	Res, Fxd, Comp, 3.3K, 1/4W
A8R14	0235-4770	Res, Fxd, Comp, 4.7K, 1/4W
A8R15,16	0203-0470	Res, Fxd, Comp, 910, 1/2W
A8R17	0109-6430	Res, Var, Film, 200
A8R18	0235-4620	Res, Fxd, Comp, 1K, 1/4W
A8R19	0235-4690	Res, Fxd, Comp, 2.2K, 1/4W
A8R20	0238-8760	Res, Fxd, MF, 90.9, 1/8W
A8R21,22	0203-0330	Res, Fxd, Comp, 240, 1/2W
A8R23,24	0237-7930	Res, Fxd, MF, 301,1W
A8R25,26	0235-4770	Res, Fxd, Comp, 4.7K, 1/4W
A8R27,28	0203-6400	Res, Fxd, Comp, 470, 2W
A8R29	0238-8760	Res, Fxd, MF, 90.9, 1/8W
A8R30	0235-4440	Res, Fxd, Comp, 180 1/4W
A8R31	0238-9160	Res, Fxd, MF, 220, 3W
A8R33,34	0235-4300	Res, Fxd, Comp, 47, 1/4W
A8R35	0238-9160	Res, Fxd, MF, 220, 3W
A8R37	0203-3650	Res, Fxd, Comp, 5.1K, 1W
A8R38	0238-9170	Res, Fxd, Film, 392, 4W
A8R39	0238-9350	Res, Fxd, WW, 180, 4W
A8R40	0238-9170	Res, Fxd, Film, 392, 4W
A8R41		See Table 5-12
A8R42		See Table 5-12
A8R43		See Table 5-12
A8Z1,2	2101-9553	Inductor assy.
A8Z3,4	2101-9551	Inductor assy.
	4003-1453	Printed Circuit Board
	4101-1400	Term, Stud
	5102-2510	Contact, Elec.



Waveforms (fig. 5-4)

When making the measurements to verify the waveforms below set the front panel controls to the initial settings listed below.

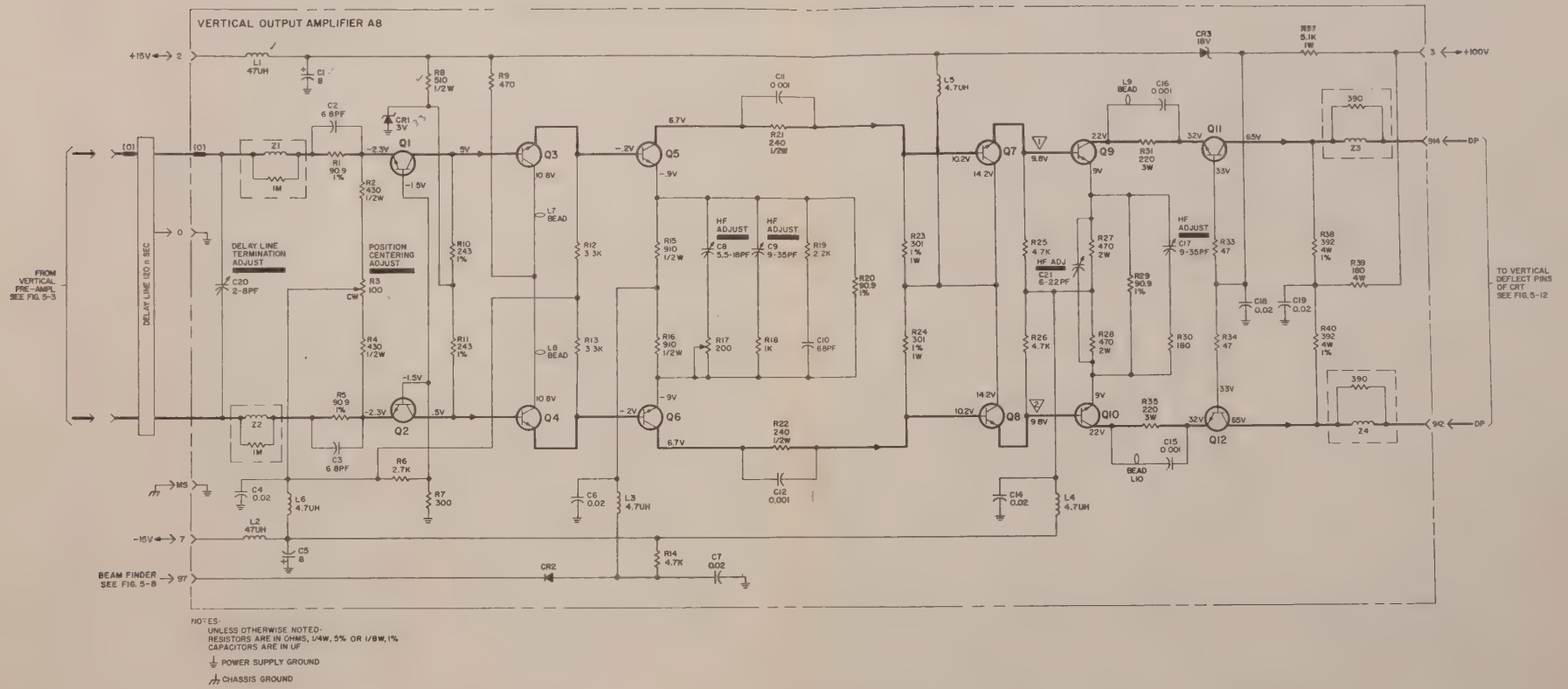
AC-GND-DC (5) (14)	— DC
VERNIER (7) (13)	— CAL
X10 GAIN (7) (13)	— push in
VERTICAL MODE (9)	— ALT
VOLTS/DIV (6) (12)	— .1
TRIG MODE (10)	— COMP
COUPLING (21) (33)	— AC
SLOPE (22) (32)	— +
SOURCE (23) (31)	— INT
SWEEP MODE (25)	— AUTO
HORIZ MODE (29)	— NORM
VERNIER (28)	— CAL
X10 GAIN (37)	— push in
MAIN SWEEP LENGTH (50)	— FULL

Connect CAL (42) to CH1 IN (1) and CH2 IN (18) and adjust LEVEL (19) for a stable trace on CRT. Trigger the test scope with the CAL (43) signal.

Voltages are measured with no signal connected, VERT MODE (10) set to Add, and position controls centered.

VERT: 1 v/div d-c coupled

HOR: 1 msec/div



NOTES:
UNLESS OTHERWISE NOTED:
RESISTORS ARE IN OHMS, 1/4W, 5% OR 1/8W, 1%
CAPACITORS ARE IN UF

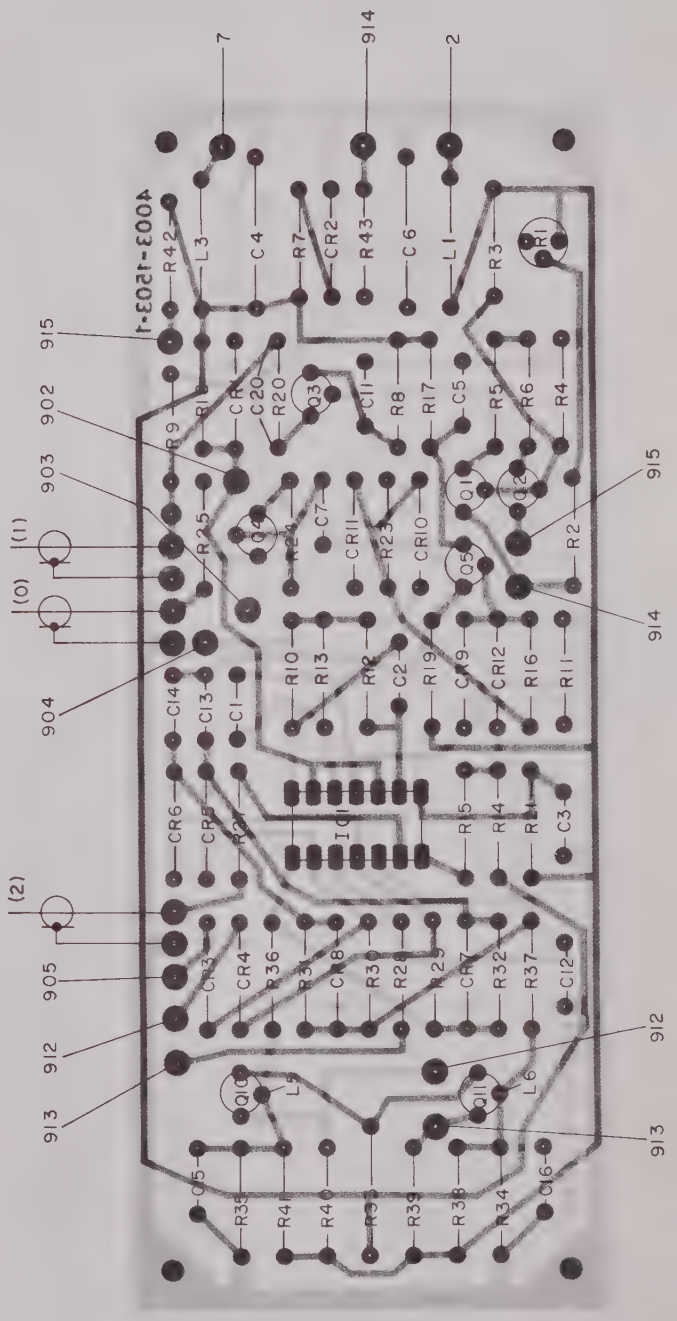
⏚ POWER SUPPLY GROUND

⏚ CHASSIS GROUND

FIG. 5-4
VERTICAL OUTPUT AMPLIFIER

TABLE 5-5

Reference Designation	Stock Number	Description
A7	8901-7803	Logic Circuit Assembly
A7C1,2	0317-5210	Cap, Fxd, Mica, 51 pf
A7C3	0319-1050	Cap, Fxd, Cer, 0.02 uf
A7C4	0328-0640	Cap, Fxd, Elect, 8 uf, 25 v
A7C5	0319-1050	Cap, Fxd, Cer, 0.02 uf
A7C6	0328-0640	Cap, Fxd, Elect, 8 uf, 25 v
A7C7	0317-5250	Cap, Fxd, Mica, 75 pf
A7C10-12	0315-1050	Cap, Fxd, Cer, 0.02 μf
A7C13,14	0317-5280	Cap, Fxd, Mica, 100 pf
A7C15,16	0317-5350	Cap, Fxd, Mica, 200 pf
A7CR1	2600-9360	Dio, Zener, IN752A
A7CR2	2601-0620	Dio, Zener, IN749A
A7CR3-12	2600-6930	Dio, Si, FD-600
A7IC1	2601-0610	Integrated Circuit, CA3046
A7L1,3	2110-2510	Ind, Mld, 47 uH
A7L5,6	2110-1560	Bead, Ferrite
A7Q1,2	2601-0160	Tstr, Si, 2N4916
A7Q3	2600-9810	Tstr, Si, 2N3640
A7Q4,5,10,11	2601-0160	Tstr, Si, 2N4916
A7R1	0109-6520	Res, Var, 10K
A7R2	0235-4850	Res, Fxd, Comp, 10K, 1/4W
A7R3	0235-5040	Res, Fxd, Comp, 62K, 1/4W
A7R4	0235-4620	Res, Fxd, Comp, 1K, 1/4W
A7R5,6	0238-9460	Res, Fxd, MF, 562, 1/8W
A7R7	0235-4560	Res, Fxd, Comp, 560, 1/4W
A7R8	0235-4620	Res, Fxd, Comp, 1K, 1/4W
A7R9	0235-4720	Res, Fxd, Comp, 3K, 1/4W
A7R10,11	0235-4620	Res, Fxd, Comp, 1K, 1/4W
A7R12,13	0235-4910	Res, Fxd, Comp, 18K, 1/4W
A7R14	0235-4840	Res, Fxd, Comp, 9.1K, 1/4W
A7R15	0235-4730	Res, Fxd, Comp, 3.3K, 1/4W
A7R16	0235-4850	Res, Fxd, Comp, 10K, 1/4W
A7R17	0235-4680	Res, Fxd, Comp, 2K, 1/4W
A7R18	0235-4520	Res, Fxd, Comp, 390, 1/4W
A7R19	0235-4770	Res, Fxd, Comp. 4.7K, 1/4W
A7R20	0235-4330	Res, Fxd, Comp, 62, 1/4W
A7R21	0235-4680	Res, Fxd, Comp, 2K 1/4W
A7R23,24	0235-4620	Res, Fxd, Comp, 1K, 1/4W
A7R25	0235-4710	Res, Fxd, Comp, 2.7K, 1/4W
A7R27,28	0235-4380	Res, Fxd, Comp, 100, 1/4W
A7R29,30	0235-4770	Res, Fxd, Comp, 4.7K, 1/4W
A7R31,32	0235-4850	Res, Fxd, Comp, 10K, 1/4W
A7R33	0203-0330	Res, Fxd, Comp, 240, 1/2W
A7R34, 35	0235-4490	Res, Fxd, Comp, 300, 1/4W
A7R36,37	0235-4540	Res, Fxd, Comp, 470, 1/4W
A7R38	0235-4710	Res, Fxd, Comp, 2.7K, 1/4W
A7R39,40	0235-4850	Res, Fxd, Comp, 10K, 1/4W
A7R41	0235-4710	Res, Fxd, Comp, 2.7K, 1/4W
A7R42,43	0235-4620	Res, Fxd, Comp, 1K, 1/4W
	4002-1503	Printed Circuit Board
A13S8,9	0501-8693	Switch, Rotary



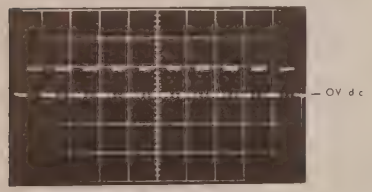
Waveforms (fig. 5-5)

When making the measurements to verify the waveforms below set the front panel controls to the initial settings listed below.

AC-GND-DC (5) (14)	– DC
VERNIER (7) (13)	– CAL
X10 GAIN (7) (13)	– push in
VERTICAL MODE (9)	– ALT
VOLTS/DIV (6) (12)	– 0.1
TRIG MODE (10)	– COMP
COUPLING (21) (33)	– AC
SLOPE (22) (32)	– +
SOURCE (23) (31)	– INT
SWEEP MODE (25)	– AUTO
HORIZ MODE (29)	– NORM
VERNIER (28)	– CAL
X10 GAIN (37)	– push in
MAIN SWEEP LENGTH (50)	– FULL

Connect CAL (42) to CH1 IN (1) and CH2 IN (18) and adjust LEVEL (19) for a stable trace on CRT. Trigger the test scope internally.

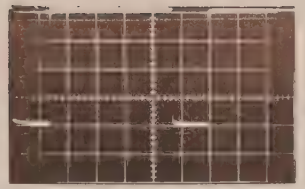
Voltages are measured with no signal connected, VERT MODE (10) set to Add, and position controls centered.



1

VERT: 1 v/div d-c coupled

HOR: 1 msec/div

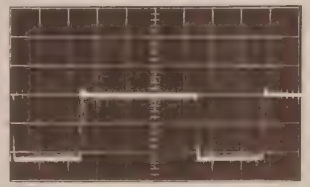


2

VERT: 2 v/div d-c coupled

HOR: 5 usec/div

For this waveform set TIME/DIV (27A)–2 usec/div and SOURCE (23)–EXT.

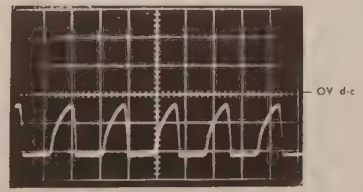


4

VERT: 2 v/div d-c coupled

HOR: 5 usec/div

For this waveform set TIME/DIV (27A)–2 usec/div and SOURCE (23)–EXT

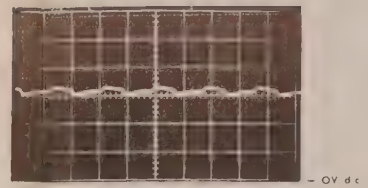


4

VERT: 2 v/div d-c coupled

HOR: 0.5 usec/div

For this waveform set VERT MODE (9)–CHOP

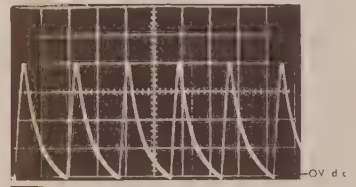


5

VERT: 5 v/div d-c coupled

HOR: 0.5 usec/div

For this waveform set VERT MODE (9)–CHOP



6

VERT: 1 v/div d-c coupled

HOR: 0.5 usec/div

For this waveform set VERT MODE (9)–CHOP and SWEEP MODE (25)–TRIG

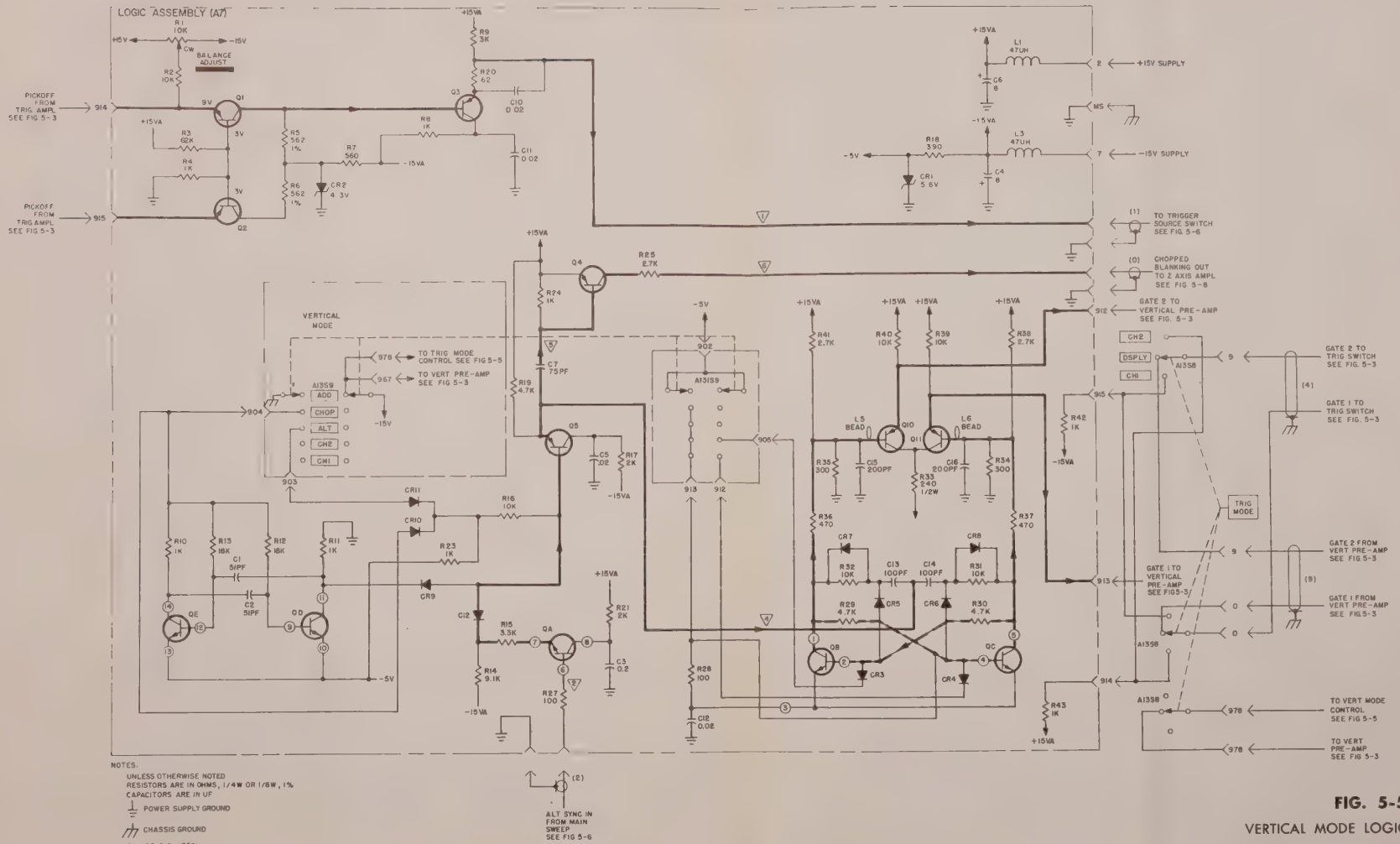

LOGIC ASSEMBLY (A7)
PICKOFF FROM TRIG AMPL SEE FIG 5-3
PICKOFF FROM TRIG AMPL SEE FIG 5-3
BALANCE ADJUST
+15V SUPPLY
-15V SUPPLY
TO TRIGGER SOURCE SWITCH SEE FIG 5-6
CHOPPED BLANKING OUT TO Z AXIS AMPL SEE FIG 5-8
GATE 2 TO VERTICAL PRE-AMP SEE FIG. 5-3
VERTICAL MODE
TO TRIG MODE CONTROL SEE FIG 5-5
TO VERT PRE-AMP SEE FIG 5-3
ADD
CHOP
ALT
CH2
CH1
GATE 2 TO TRIG SWITCH SEE FIG. 5-3
GATE 1 TO TRIG SWITCH SEE FIG. 5-3
TRIG MODE
GATE 2 FROM VERT PRE-AMP SEE FIG 5-3
GATE 1 TO VERTICAL PRE-AMP SEE FIGS-3
GATE 1 FROM VERT PRE-AMP SEE FIG.5-3
TO VERT MODE CONTROL SEE FIG 5-5
TO VERT PRE-AMP SEE FIG 5-3
ALT SYNC IN FROM MAIN SWEEP SEE FIG 5-6
NOTES.
UNLESS OTHERWISE NOTED RESISTORS ARE IN OHMS, 1/4W OR 1/8W, 1% CAPACITORS ARE IN UF
POWER SUPPLY GROUND
CHASSIS GROUND
QA-QE P/O A7IC1

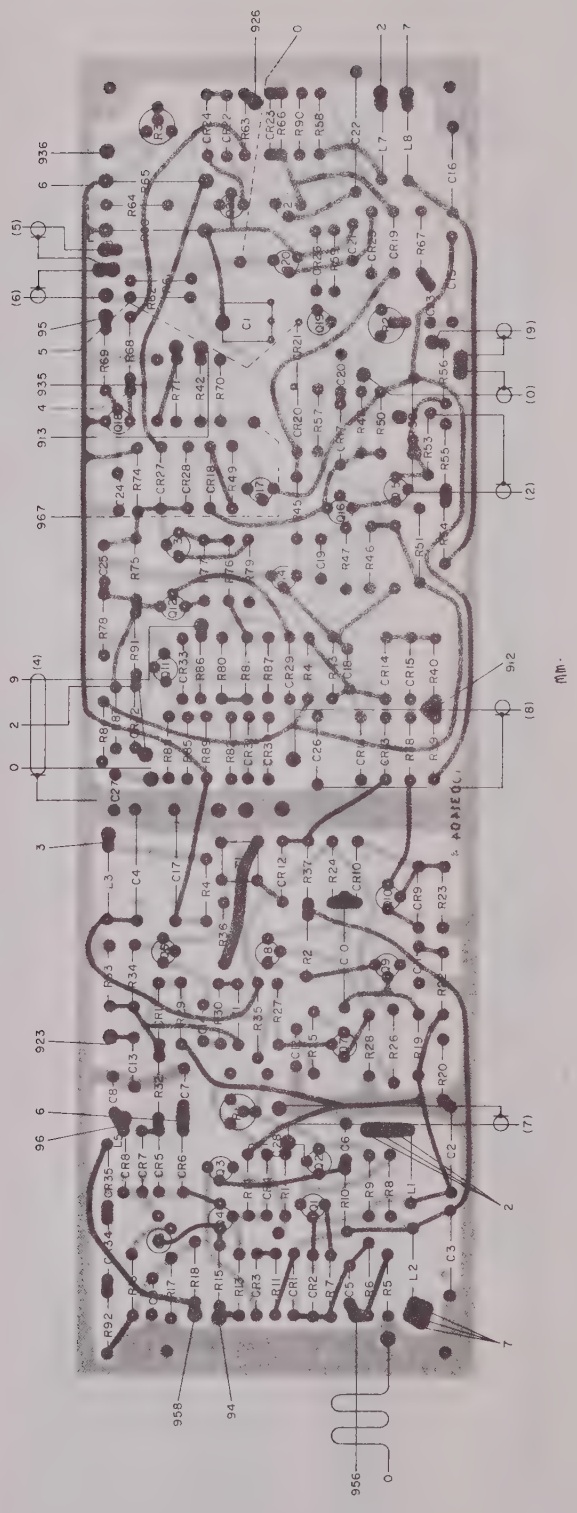
FIG. 5-5

VERTICAL MODE LOGIC

TABLE 5-6

Reference Designation	Stock Number	Description
A1	8901-7606	Main Sweep Assembly
A1C1	0328-1130	Cap, Var, 1.5—11.6 pf
A1C2,3	0328-0640	Cap, Fxd, Elect, 8 μf, 25v
A1C4	0328-0770	Cap, Fxd, Elect, 3 μf, 150v
A1C5	0328-1230	Cap, Fxd, Cer, 0.002 μf
A1C6	0317-5320	Cap, Fxd, Mica, 150 pf
A1C7,8,9	0319-1050	Cap. Fxd, Cer, 0.02 μf
A1C10	0328-0770	Cap, Fxd, Elect, 3 μf, 150v
A1C11	0319-1050	Cap, Fxd, Cer, 0.02 μf
A1C12	0317-5280	Cap, Fxd, Mica, 100 pf
A1C13	0327-3270	Cap, Fxd, Cer, 0.1 μf
A1C14	0317-5190	Cap, Fxd, Mica, 47 pf
A1C15,16	0328-0640	Cap, Fxd, Elect, 8 μf, 25v
A1C17	0328-0770	Cap, Fxd, Elect, 3 μf, 150v
A1C18	0317-5760	Cap, Fxd, Mica, 560 pf
A1C19	0317-5220	Cap, Fxd, Mica, 56 pf
A1C20	0319-1050	Cap, Fxd, Cer, 0.02 μf
A1C21	0317-5060	Cap, Fxd, Mica, 10 pf
A1C22	0328-0710	Cap, Fxd, Elect, 75 μf, 25v
A1C23	0317-5410	Cap, Fxd, Mica, 330 pf
A1C24	0319-1050	Cap, Fxd, Cer, 0.02 μf
A1C25	0317-5170	Cap, Fxd, Mica, 39 pf
A1C26	0328-1330	Cap, Fxd, 0.01 μf
A1C27	0319-1050	Cap, Fxd, Cer, 0.02 μf
A1C28	0317-5170	Cap, Fxd, Mica, 39 pf
A1CR1,2	2601-2320	Dio, Si, FD-300
A1CR3	2600-9360	Dio, Zener, 1N752A
A1CR4-10	2600-6930	Dio, Si, FD100
A1CR11	2600-8150	Dio, Tunnel, 1N3717
A1CR12-15	2600-6930	Dio, Si, FD100
A1CR16	2600-8150	Dio, Tunnel, 1N3717
A1CR17-33	2600-6930	Dio, Si, FD100
A1CR34,35	2600 9360	Dio, Zen, 1N752A
A1L1-3	2110-2520	Ind, Mld, 100 μH
A1L4,5	2110-1560	Bead, Ferrite
A1L7,8	2110-2520	Ind, Mld, 100 μH
A1Q1	2601-0440	Tstr, Field Effect, 2N4340
A1Q2	2601-0160	Tstr, Si, 2N4916
A1Q3	2601-0420	Tstr, Si, 2N3694
A1Q4,5	2601-0210	Tstr, Si, 2N5179
A1Q6,7	2601-0130	Tstr, Si, 2N4313
A1Q8	2601-0210	Tstr, Si, 2N5179
A1Q9	2601-0420	Tstr, Si, 2N3694
A1Q10	2601-0140	Tstr, Si, 2N4250
A1Q11	2601-0280	Tstr, Si, 2N4410
A1Q12	2600-9810	Tstr, Si, 2N3640
A1Q13	2601-0460	Tstr, Si, 2N4917
A1Q14	2601-0270	Tstr, Ge, 2N964
A1Q15,16	2600-9880	Tstr, Si, 2N3646
A1Q17	2600-9860	Tstr, Si, 2N3565
A1Q18	2601-0280	Tstr, Si, 2N4410
A1Q19	2601-0440	Tstr, Field Effect, 2N4340
A1Q20	2600-9860	Tstr, Si, 2N3565
A1Q21,22	2601-0140	Tstr, Si, 2N4250
A1R1	0109-6330	Res, Var, WW, 500
A1R2	0109-6340	Res, Var, WW, 5K
A1R3	0109-6350	Res, Var, WW, 20K
A1R4	0235-4140	Res, Fxd, Comp, 10, ¼W
A1R5	0235-5330	Res, Fxd, Comp, 1M, ¼W
A1R6	0203-1050	Res, Fxd, Comp, 240K, ½W
A1R7	0235-4380	Res, Fxd, Comp, 100, ¼W
A1R8	0235-4890	Res, Fxd, Comp, 15K, ¼W
A1R9	0235-4640	Res, Fxd, Comp, 1.2K, ¼W
A1R10	0235-4650	Res, Fxd, Comp, 1.5K, ¼W
A1R11	0235-4300	Res, Fxd, Comp, 47, ¼W
A1R12	0235-4510	Res, Fxd, Comp, 360, ¼W
A1R13	0235-4850	Res, Fxd, Comp, 10K, ¼W
A1R14	0235-5010	Res, Fxd, Comp, 47K, ¼W
A1R15	0235-4670	Res, Fxd, Comp, 1.8K, ¼W
A1R16	0235-4380	Res, Fxd, Comp, 100, ¼W
A1R17	0235-4540	Res, Fxd, Comp, 470, ¼W
A1R18	0235-4990	Res, Fxd, Comp, 39K, ¼W
A1R19	0235-4850	Res, Fxd, Comp, 10K, ¼W
A1R20	0235-4480	Res, Fxd, Comp, 270, ¼W
A1R21	0235-4680	Res, Fxd, Comp, 2K, ¼W
A1R22	0235-4300	Res, Fxd, Comp, 47, ¼W
A1R23,24	0235-5110	Res, Fxd, Comp, 120K, ¼W
A1R25	0235-4300	Res, Fxd, Comp, 47, ¼W
A1R26	0203-0820	Res, Fxd, Comp, 27K, ½W
A1R27,28	0235-4380	Res, Fxd, Comp, 100, ¼W
A1R29	0235-4580	Res, Fxd, Comp, 680, ¼W
A1R30	0235-4310	Res, Fxd, Comp, 51, ¼W
A1R32	0235-4340	Res, Fxd, Comp, 68, ¼W
A1R33	0235-4770	Res, Fxd, Comp, 4.7K, ¼W
A1R34	0235-4380	Res, Fxd, Comp, 100, ¼W
A1R35	0203-0870	Res, Fxd, Comp, 43K, ½W
A1R36	0235-4380	Res, Fxd, Comp, 100, ¼W
A1R37	0235-4800	Res, Fxd, Comp, 6.2K, ¼W
A1R38	0235-4700	Res, Fxd, Comp, 2.4K, ¼W
A1R39	0235-5090	Res, Fxd, Comp, 100K, ¼W
A1R40	0235-4800	Res, Fxd, Comp, 6.2K, ¼W
A1R41	0235-4780	Res, Fxd, Comp, 5.1K, ¼W
A1R42	0235-5010	Res, Fxd, Comp, 47K, ¼W
A1R43	0235-4450	Res, Fxd, Comp, 200, ¼W
A1R45	0235-4590	Res, Fxd, Comp, 750, ¼W
A1R46	0235-4760	Res, Fxd, Comp, 4.3K, ¼W
A1R47	0235-4710	Res, Fxd, Comp, 2.7K, ¼W
A1R48	0235-4730	Res, Fxd, Comp, 3.3K, ¼W
A1R49	0235-4690	Res, Fxd, Comp, 2.2K, ¼W
A1R50	0237-6280	Res, Fxd, Comp, 1.3K, ¼W
A1R51	0203-0450	Res, Fxd, Comp, 750, ½W
A1R52	0235-4690	Res, Fxd, Comp, 2.2K, ¼W
A1R53	0235-4630	Res, Fxd, Comp, 1.1K, ¼W
A1R54	0235-4710	Res, Fxd, Comp, 2.7K, ¼W
A1R55	0235-4500	Res, Fxd, Comp, 330, ¼W
A1R56	0235-4620	Res, Fxd, Comp, 1K, ¼W
A1R57	0235-4730	Res, Fxd, Comp, 3.3K, ¼W
A1R58	0235-4890	Res, Fxd, Comp, 15K, ¼W
A1R59	0235-4380	Res, Fxd, Comp, 100, ¼W
A1R60	0203-3760	Res, Fxd, Comp, 15K, 1W
A1R61	0238-8890	Res, Fxd, MF, 3.57K, 1/8W
A1R62	0235-4800	Res, Fxd, Comp, 6.2K, ¼W
A1R63	0235-4790	Res, Fxd, Comp, 5.6K, ¼W
A1R64	0235-4380	Res, Fxd, Comp, 100, ¼W
A1R65	0203-3800	Res, Fxd, Comp, 22K, 1W
A1R66	0235-4620	Res, Fxd, Comp, 1K, ¼W
A1R67	0235-4380	Res, Fxd, Comp, 100, ¼W
A1R68	0235-5090	Res, Fxd, Comp, 100K, ¼W
A1R69	0235-4380	Res, Fxd, Comp, 100, ¼W
A1R70	0235-5470	Res, Fxd, Comp, 3.9M, ¼W
A1R71	0235-5310	Res, Fxd, Comp, 820K, ¼W
A1R74	0235-5330	Res, Fxd, Comp, 1M, ¼W
A1R75	0235-4910	Res, Fxd, Comp, 18K, ¼W
A1R76	0235-4680	Res, Fxd, Comp, 2K, ¼W
A1R77	0235-4300	Res, Fxd, Comp, 47, ¼W
A1R78	0235-4640	Res, Fxd, Comp, 1.2K, ¼W
A1R79	0235-4540	Res, Fxd, Comp, 470, ¼W
A1R80	0235-4620	Res, Fxd, Comp, 1K, ¼W
A1R81	0235-4710	Res, Fxd, Comp, 2.7K, ¼W
A1R82	0235-4620	Res, Fxd, Comp, 1K, ¼W
A1R83	0235-4950	Res, Fxd, Comp, 27K, ¼W
A1R84	0235-5240	Res, Fxd, Comp, 430K, ¼W
A1R85	0235-5250	Res, Fxd, Comp, 470K, ¼W
A1R86	0235-4640	Res, Fxd, Comp, 1.2K, ¼W
A1R87	0235-5090	Res, Fxd, Comp, 100K, ¼W
A1R88	0235-5090	Res, Fxd, Comp, 100K, ¼W
A1R89	0235-5250	Res, Fxd, Comp, 470K, ¼W
A1R90	0235-4460	Res, Fxd, Comp, 220, ¼W
A1R91	0235-4640	Res, Fxd, Comp, 1.2K, ¼W
A1R92	0235-4690	Res, Fxd, Comp, 2.2K, ¼W
A1T1	2101-9561	Ind, Assy

Reference Designation	Stock Number	Description
A1Z1	2101-9552	Ind, Assy
	4003-1404	Printed Circuit Board
	3601-1450	Ret, Cap, Nylon
	5102-2730	Recp, Tef
A13C8	0313-3680	Cap, Fxd, Comp, 5.6 pf
A13C9	0317-5170	Cap, Fxd, Mica, 39 pf
A13C11	0313-3960	Cap, Fxd, Comp, 10 pf
A13C12	0317-5280	Cap, Fxd, Mica, 100 pf
A13R7	0235-4140	Res, Fxd, Comp, 10, ¼W
A13R8	0235-5320	Res, Fxd, Comp, 910K, ¼W
A13R9	0235-5100	Res, Fxd, Comp, 110K, ¼W
A13R10,11	0235-5090	Res, Fxd, Comp, 100K, ¼W
A13R12,13,14	0107-3472	Res, Var, Comp, Triple
A13S1	0503-2730	Switch, Toggle, SPDT; Light
A13S2,LT1	0503-2800	Switch, P.B., SPST
A13S4A,B,C	0501-8001	Switch, Lever, Triple
C8	0328-1320	Cap, Fxd, Film 0.056 uf



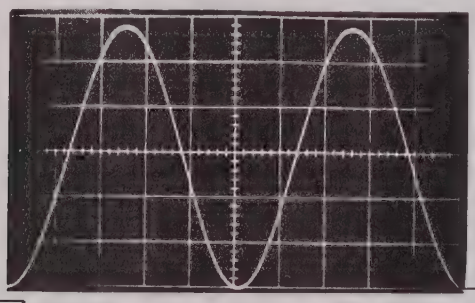
Waveforms (fig. 5-6)

When making the measurements to verify the waveforms below set the front panel controls to the initial settings listed below.

AC-GND-DC (5) (14)	— DC
VERNIER (7) (13)	— CAL
X10 GAIN (7) (13)	— push in
VERTICAL MODE (9)	— ALT
VOLTS/DIV (6) (12)	— .1
TRIG MODE (10)	— COMP
COUPLING (21) (33)	— AC
SLOPE (22) (32)	— +
SOURCE (23) (31)	— EXT/10
SWEEP MODE (25)	— TRIG
HORIZ MODE (29)	— NORM
VERNIER (28)	— CAL
X10 GAIN (37)	— push in
MAIN SWEEP LENGTH (50)	— FULL
TIME/DIV (27A)	— 50 usec/div

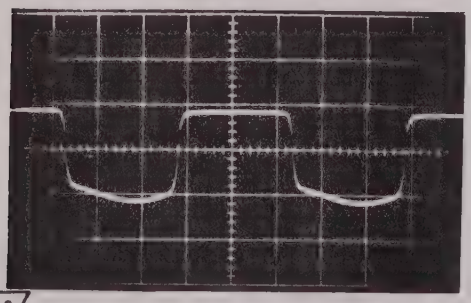
Connect a 1 KHZ, 12v p-p sine wave to the TRIG IN (24) connector. Trigger the test scope from this signal also.

Voltages are measured with no signals connected, LEVEL (19)—centered and SWEEP MODE (25)—SINGLE. Voltages in parenthesis are when REARM (26) is depressed.



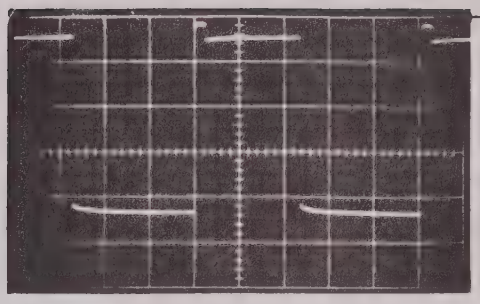
1

VERT: .2 v/div d-c coupled
HOR: .2 msec/div



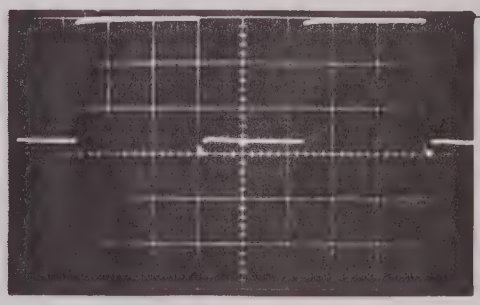
2

VERT: .5 v/div a-c coupled
HOR: .2 msec/div
Adjust LEVEL (19) to get the waveform



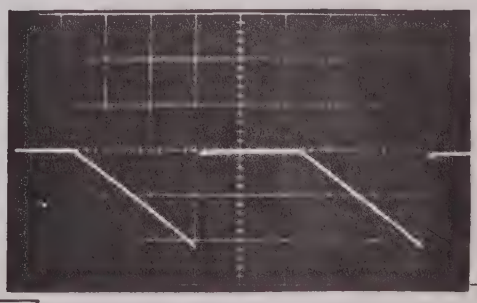
3

VERT: .1 v/div d-c coupled
HOR: .2 msec/div



4

VERT: 1 v/div d-c coupled
HOR: .2 msec/div



5

VERT: 5 v/div d-c coupled
HOR: .2 msec/div

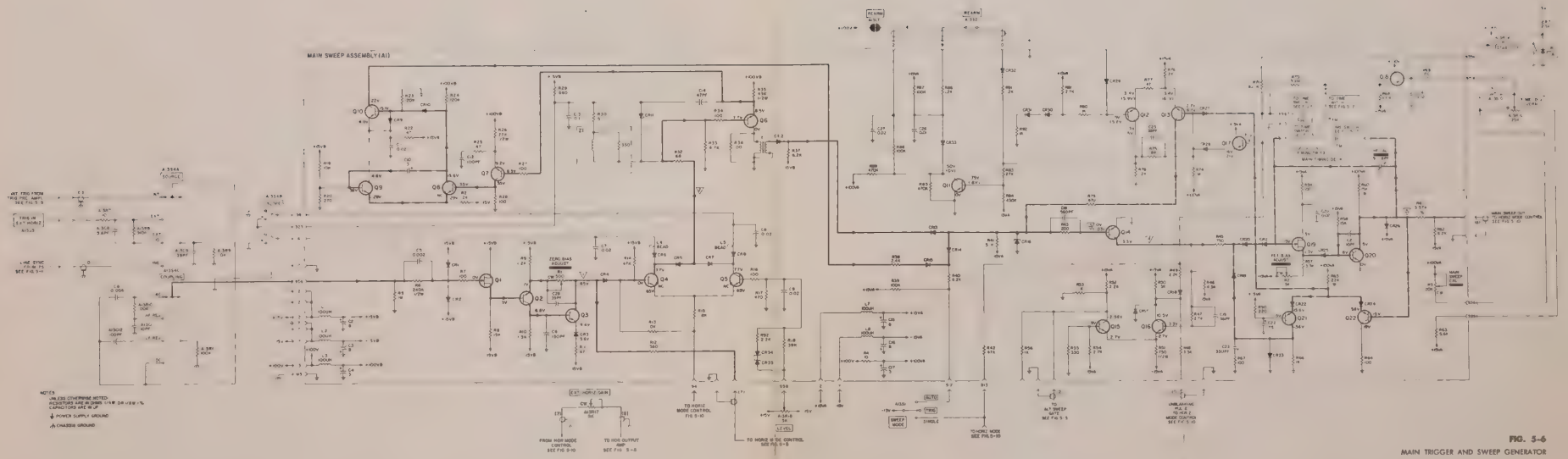

MAIN SWEEP ASSEMBLY (A1)
NOTES:
UNLESS OTHERWISE NOTED:
RESISTORS ARE IN OHMS 1/4 W OR VERY 1%
CAPACITORS ARE IN UF
POWER SUPPLY GROUND
CHASSIS GROUND
TO HORIZ MODE CONTROL FIG 5-10
TO HORIZ MODE SEE FIG 5-10
TO ALT SWEEP GATE SEE FIG 5-5
TO HORIZ MODE SEE FIG 5-10
FROM HOR MODE CONTROL SEE FIG 5-10
TO HOR OUTPUT AMP SEE FIG 5-6
TO HORIZ MODE CONTROL SEE FIG 5-10
MAIN SWEEP OUT TO HORIZ MODE CONTROL SEE FIG 5-10

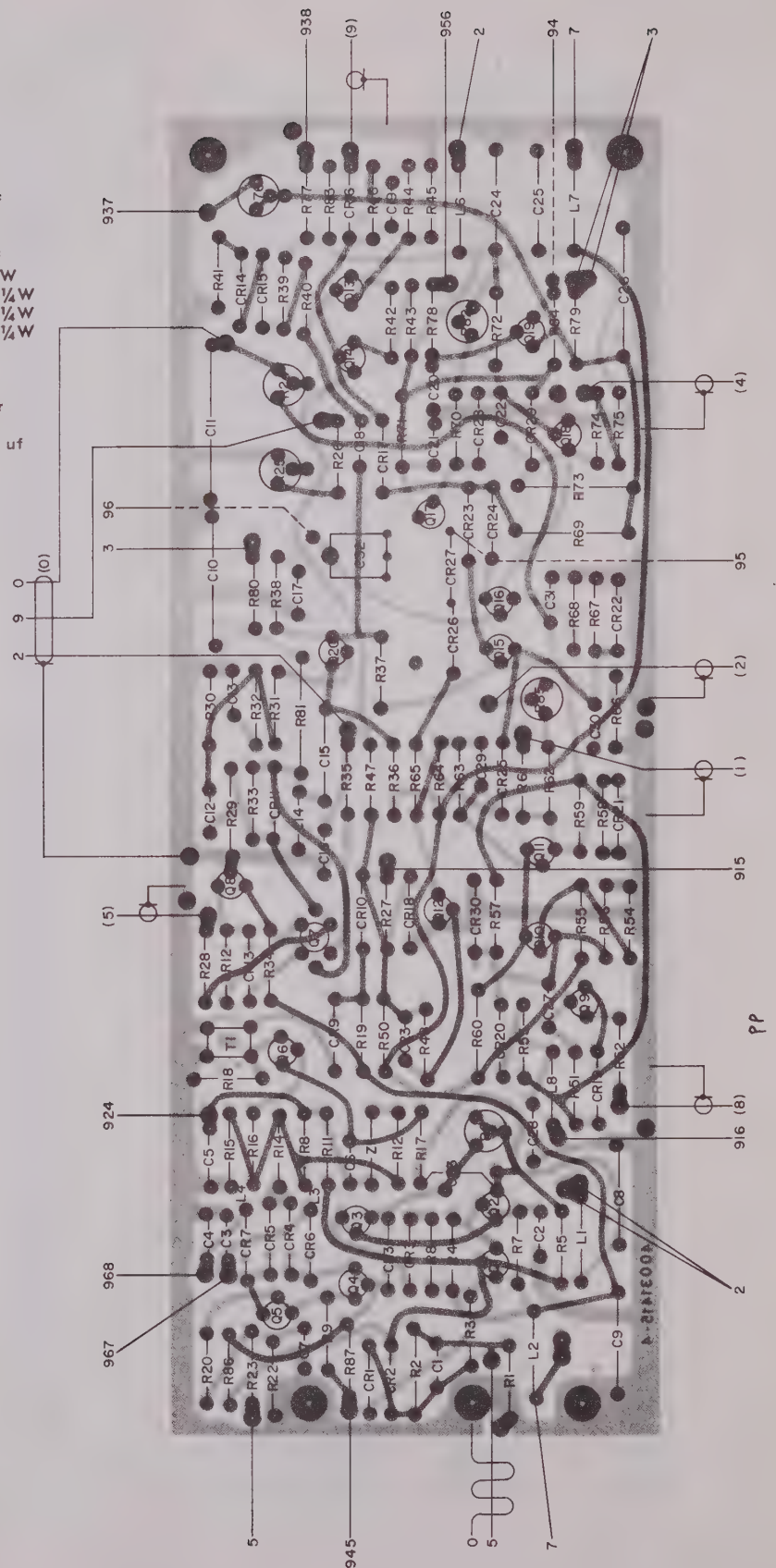
FIG. 5-6
MAIN TRIGGER AND SWEEP GENERATOR

5-17/5-18

TABLE 5-7

Reference Designation	Stock Number	Description
A2	8901-7828	Delayed Sweep Assy.
A2C1	0328-1230	Cap, Fxd, Cer, 0.002 μf
A2C2	0317-5320	Cap, Fxd, Mica, 150 pf
A2C3,4	0319-1050	Cap, Fxd, Cer, 0.02 μf
A2C5	0327-3270	Cap, Fxd, Cer, 0.1 μf
A2C6	0317-5350	Cap, Fxd, Mica, 200 pf
A2C7	0319-1050	Cap, Fxd, Cer, 0.02 μf
A2C8,9	0328-0640	Cap, Fxd, Elect, 8 μf, 25v
A2C10	0328-0770	Cap, Fxd, Elect, 3 μf, 150v
A2C11	0328-1260	Cap, Fxd, Elect, 90 μf, 15v
A2C12	0319-1050	Cap, Fxd, Cer, 0.02 μf
A2C13	0317-5170	Cap, Fxd, Mica, 39 pf
A2C14	0327-3270	Cap, Fxd, Cer, 0.1 μf
A2C15	0328-1390	Cap, Fxd, Mylar, 0.022 μf
A2C16-18	0319-1050	Cap, Fxd, Cer, 0.02 μf
A2C19	0317-5170	Cap, Fxd, Mica, 39 pf
A2C20,21	0319-1050	Cap, Fxd, Cer, 0.02 μf
A2C22	0317-5060	Cap, Fxd, Mica, 10 pf
A2C23	0317-5760	Cap, Fxd, Mica, 560 pf
A2C24,25	0328-0640	Cap, Fxd, Elect, 8 μf, 25v
A2C26	0328-0770	Cap, Fxd, Elect, 3 μf, 150v
A2C27	0317-5110	Cap, Fxd, Mica, 22 pf
A2C28	0327-3270	Cap, Fxd, Cer, 0.1 μf
A2C29	0317-5220	Cap, Fxd, Mica, 56 pf
A2C30	0317-5410	Cap, Fxd, Mica, 330 pf
A2C31	0319-1050	Cap, Fxd, Cer, 0.02 μf
A2C32	0328-1130	Cap, Var, 1.5—11.6 pf
A2C33	0317-5170	Cap, Fxd, Mica, 39 pf
A2CR1,2	2601-2320	Dio, Si, FD-300
A2CR3	2600-9360	Dio, Zener, 1N752A
A2CR4-7	2600-6930	Dio, Si, FD-100
A2CR8	2600-8150	Dio, Tunnel, 1N3717
A2CR9,10	2600-6930	Dio, Si, FD-100
A2CR11	2600-8150	Dio, Tunnel, 1N3717
A2CR12-17	2600-6930	Dio, Si, FD-100
A2CR18	2600-8150	Dio, Tunnel, 1N3717
A2CR19-31	2600-6930	Dio, Si, FD-100
A2L1,2	2110-2520	Ind, Mld, 100 μH
A2L3,4	2110-1560	Bead, Ferrite
A2L6,7	2110-2520	Ind, Mld, 100 μH
A2L8	2110-2500	Ind, Mld, 4.7 μH
A2Q1	2601-0440	Tstr, 2N4340
A2Q2	2601-0160	Tstr, 2N4916
A2Q3	2601-0420	Tstr, 2N3694
A2Q4,5	2601-0210	Tstr, 2N5179
A2Q6	2601-0130	Tstr, 2N4313
A2Q7	2601-0390	Tstr, Dual TD-101
A2Q8	2600-9860	Tstr, 2N3565
A2Q9	2601-0160	Tstr, 2N4916
A2Q10,11	2600-9880	Tstr, 2N3646
A2Q12	2601-0270	Tstr, 2N964
A2Q13	2600-9810	Tstr, 2N3640
A2Q14	2601-0460	Tstr, 2N4917
A2Q15,16	2601-0140	Tstr, 2N4250
A2Q17	2601-0440	Tstr, 2N4340
A2Q18	2600-9860	Tstr, 2N3565
A2Q19	2601-0280	Tstr, 2N4410
A2Q20	2631-3490	Tstr, 2N3563
A2R1	0235-5330	Res, Fxd, Comp, 1M, ¼W
A2R2	0203-1050	Res, Fxd, Comp, 240K, ½W
A2R3	0235-4380	Res, Fxd, Comp, 100, ¼W
A2R4	0235-4890	Res, Fxd, Comp, 15K, ¼W
A2R5	0235-4640	Res, Fxd, Comp, 1.2K, ¼W
A2R6	0109-6330	Res, Var, WW, 500
A2R7	0235-4650	Res, Fxd, Comp, 1.5K, ¼W
A2R8	0235-4300	Res, Fxd, Comp, 47, ¼W
A2R9	0235-4670	Res, Fxd, Comp, 1.8K, ¼W
A2R11	0235-4580	Res, Fxd, Comp, 680, ¼W
A2R12	0235-4310	Res, Fxd, Comp, 51, ¼W
A2R14	0235-4340	Res, Fxd, Comp, 68, ¼W
A2R15	0235-4770	Res, Fxd, Comp, 4.7K, ¼W
A2R16	0235-4380	Res, Fxd, Comp, 100, ¼W
A2R17	0235-4890	Res, Fxd, Comp, 15K, ¼W
A2R18	0235-4380	Res, Fxd, Comp, 100, ¼W
A2R19	0235-4800	Res, Fxd, Comp, 6.2K, ¼W
A2R20	0235-4380	Res, Fxd, Comp, 100, ¼W
A2R22	0235-4540	Res, Fxd, Comp, 470, ¼W
A2R23	0235-4750	Res, Fxd, Comp, 3.9K, ¼W
A2R24,25	0109-6330	Res, Var, WW, 500
A2R26	0235-4540	Res, Fxd, Comp, 470, ¼W
A2R27	0235-4800	Res, Fxd, Comp, 6.2K, ¼W
A2R28	0235-4380	Res, Fxd, Comp, 100, ¼W
A2R29	0203-0690	Res, Fxd, Comp, 7.5K, ½W
A2R30	0235-4620	Res, Fxd, Comp, 1K, ¼W
A2R31	0235-4260	Res, Fxd, Comp, 33, ¼W
A2R32	0235-4140	Res, Fxd, Comp, 10, ¼W
A2R33	0235-4350	Res, Fxd, Comp, 75, ¼W
A2R34	0235-4750	Res, Fxd, Comp, 3.9K, ¼W
A2R35	0235-4380	Res, Fxd, Comp, 100, ¼W
A2R36	0235-4730	Res, Fxd, Comp, 3.3K, ¼W
A2R37	0235-4680	Res, Fxd, Comp, 2K, ¼W
A2R38	0235-4450	Res, Fxd, Comp, 200, ¼W
A2R39	0235-4710	Res, Fxd, Comp, 2.7K, ¼W
A2R40,41	0235-4620	Res, Fxd, Comp, 1K, ¼W
A2R42	0235-4300	Res, Fxd, Comp, 47, ¼W
A2R43	0235-4680	Res, Fxd, Comp, 2K, ¼W
A2R44	0235-4910	Res, Fxd, Comp, 18K, ¼W
A2R45	0235-4640	Res, Fxd, Comp, 1.2K, ¼W
A2R46	0235-5330	Res, Fxd, Comp, 1M, ¼W
A2R47	0235-4540	Res, Fxd, Comp, 470, ¼W
A2R48	0235-4450	Res, Fxd, Comp, 200, ¼W
A2R50	0235-4780	Res, Fxd, Comp, 5.1K, ¼W
A2R51	0235-4670	Res, Fxd, Comp, 1.8K, ¼W
A2R52	0235-4620	Res, Fxd, Comp, 1K, ¼W
A2R53	0235-4890	Res, Fxd, Comp, 15K, ¼W
A2R54	0235-4500	Res, Fxd, Comp, 330, ¼W
A2R55	0235-4710	Res, Fxd, Comp, 2.7K, ¼W
A2R56	0235-4590	Res, Fxd, Comp, 750, ¼W
A2R57	0237-6280	Res, Fxd, Comp, 1.3K, ¼W
A2R58	0235-4590	Res, Fxd, Comp, 750, ¼W
A2R59	0237-6280	Res, Fxd, Comp, 1.3K, ¼W
A2R60	0203-0450	Res, Fxd, Comp, 750, ½W
A2R61	0235-4730	Res, Fxd, Comp, 3.3K, ¼W
A2R62	0235-4850	Res, Fxd, Comp, 10K, ¼W
A2R63	0235-4710	Res, Fxd, Comp, 2.7K, ¼W
A2R64	0235-4760	Res, Fxd, Comp, 4.3K, ¼W
A2R65	0235-4590	Res, Fxd, Comp, 750, ¼W
A2R66	0235-4380	Res, Fxd, Comp, 100, ¼W
A2R67	0235-4620	Res, Fxd, Comp, 1K, ¼W
A2R68	0235-4380	Res, Fxd, Comp, 100, ¼W
A2R69	0203-3800	Res, Fxd, Comp, 22K, 1W
A2R70	0235-4730	Res, Fxd, Comp, 3.3K, ¼W
A2R71	0235-4380	Res, Fxd, Comp, 100, ¼W
A2R72	0235-4890	Res, Fxd, Comp, 15K, ¼W
A2R73	0203-3760	Res, Fxd, Comp, 15K, 1W
A2R74	0238-8890	Res, Fxd, MF, 3.57K, 1/8W
A2R75	0235-4800	Res, Fxd, Comp, 6.2K, ¼W
A2R76	0109-6350	Res, Var, WW, 20K
A2R77	0235-4790	Res, Fxd, Comp, 5.6K, ¼W
A2R78	0235-4380	Res, Fxd, Comp, 100, ¼W
A2R79,80	0235-4140	Res, Fxd, Comp, 10, ¼W
A2R81	0203-3750	Res, Fxd, Comp, 13K, 1W
A2R82	0109-6450	Res, Var, WW, 5K
A2R83	0235-4710	Res, Fxd, Comp, 2.7K, ¼W
A2R84	0235-5090	Res, Fxd, Comp, 100K, ¼W
A2R85	0109-6460	Res, Var, Film, 100K
A2R86	0235-5010	Res, Fxd, Comp, 47K, ¼W
A2R87	0235-4850	Res, Fxd, Comp, 10K, ¼W
A2T1	2101-9561	Ind. assy.
A2Z1	2101-9552	Ind. assy.
	4003-1415	Printed Circuit Board
	5102-2730	Recp, Tef
	5102-2760	Pin, Conn.

A13C1	0313-3680	Cap, Fxd, Comp, 5.6 pf
A13C2	0317-5170	Cap, Fxd, Mica, 39 pf
A13C3	0313-3960	Cap, Fxd, Comp, 10 pf
A13C5	0317-5280	Cap, Fxd, Mica, 100 pf
A13R1	0235-4140	Res, Fxd, Comp, 10, ¼W
A13R2	0235-5320	Res, Fxd, Comp, 910K, ¼W
A13R3	0235-5100	Res, Fxd, Comp, 110K, ¼W
A13R4,5	0235-5090	Res, Fxd, Comp, 100K, ¼W
A13R6	0107-3501	Res, Var, Comp, 5K
A13S5A,B,C,	0501-8001	Switch, Lever, Triple
A14R3	0109-0920	Res, Var, Potentiometer
C9	0328-1320	Cap, Fxd, Film, 0.056 uf
S2	0503-2390	Switch, Slide



Waveforms (Fig. 5-7)

Refer to Fig. 5-6 for waveforms

Voltages measured with DELAY VERNIER (33) at 1, LEVEL (34) set to zero, and with settings on Fig. 5-6.

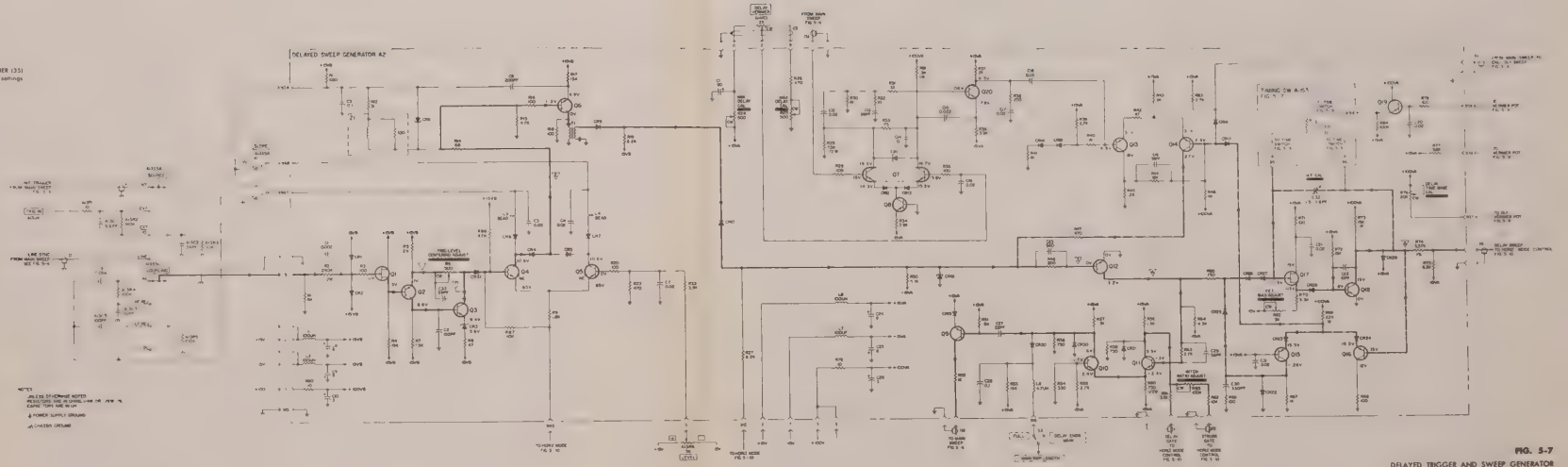
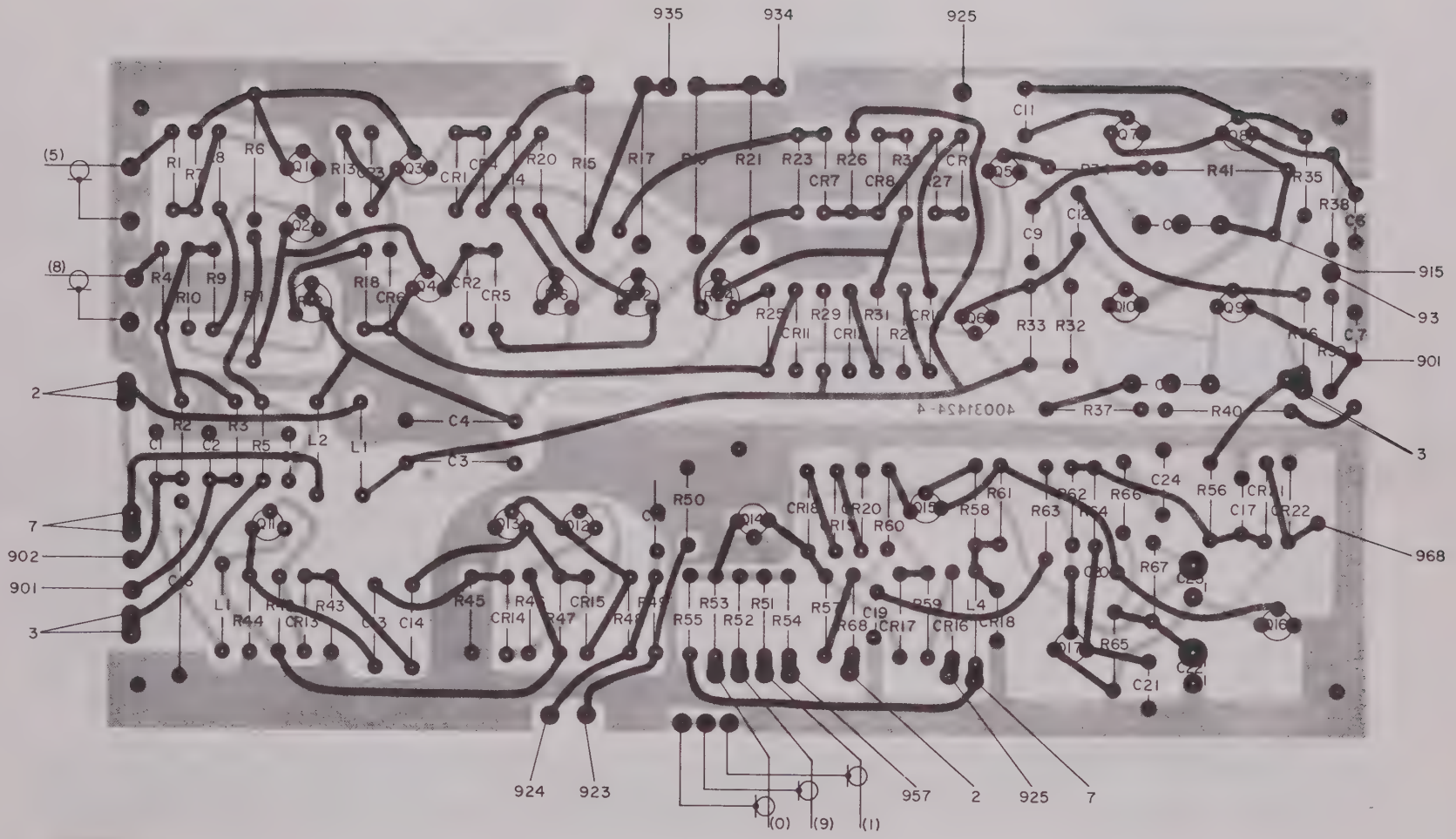

DELAYED SWEEP GENERATOR A2
TO HORIZ MODE
TO TRIGGERING MODE
TO DELAY PICKOFF POT
TO DELAY TIME MULTIPLIER POT
TO DELAY SWEEP TRIGGERING MODE CONTROL

FIG. 5-7
DELAYED TRIGGER AND SWEEP GENERATOR

5-21/5-22

TABLE 5-8

Reference Designation	Stock Number	Description
A3	8901-7813	Horizontal Output Assy.
A3C1,2	0319-1050	Cap, Fxd, Cer, 0.02 μf
A3C3,4	0328-0640	Cap, Fxd, Elect, 8 μf, 25v
A3C5-7	0319-1050	Cap, Fxd, Cer, 0.02 μf
A3C8	0319-1262	Cap, Var, 0.65—3.2 pf
A3C9	0327-3600	Cap, Var, Cer, 2—8 pf
A3C10	0319-1262	Cap, Var, 0.65—3.2 pf
A3C11,12	0319-1050	Cap, Fxd, Cer, 0.02 μf
A3C13,14	0328-1330	Cap, Fxd, 0.01 μf
A3C15	0317-5750	Cap, Fxd, Mica, 1000 pf
A3C16	0328-0710	Cap, Fxd, Elect, 75 μf, 25v
A3C17-21	0319-1050	Cap, Fxd, Cer, 0.02 μf
A3C22,23	0327-3920	Cap, Var, Tef, 0.2—1.5 pf
A3C24	0313-3900	Cap, Fxd, Comp, 3.3 pf
A3CR1-20	2600-6930	Dio, Si, FD-100
A3CR21,22	2601-2320	Dio, Si, FD-300
A3L1-4	2110-2520	Ind, Mld, 100 μH
A3Q1,2	2601-0420	Tstr, Si, 2N3694
A3Q3-6	2601-0160	Tstr, Si, 2N4916
A3Q7	2601-0400	Tstr, Si, MM3001
A3Q8,9	2601-0470	Tstr, Si, 2N4929
A3Q10	2601-0400	Tstr, Si, MM3001
A3Q11-13	2601-0160	Tstr, Si, 2N4916
A3Q14,15	2631-3490	Tstr, Si, 2N3563
A3Q16	2601-0400	Tstr, Si, MM3001
A3Q17	2601-0470	Tstr, Si, 2N4929
A3R1	0235-4310	Res, Fxd, Comp, 51, ¼W
A3R2	0235-5020	Res, Fxd, Comp, 51K, ¼W
A3R3	0235-4780	Res, Fxd, Comp, 5.1K, ¼W
A3R4	0235-4310	Res, Fxd, Comp, 51, ¼W
A3R5	0235-4140	Res, Fxd, Comp, 10, ¼W
A3R6	0203-3720	Res, Fxd, Comp, 10K, 1W
A3R7	0238-8870	Res, Fxd, MF, 2.55K, 1/8W
A3R8,9	0238-8900	Res, Fxd, MF, 3.83K, 1/8W
A3R10	0238-8870	Res, Fxd, MF, 2.55K, 1/8W
A3R11	0203-3720	Res, Fxd, Comp, 10K, 1W
A3R12	0109-6310	Res, Var, Film, 100
A3R13	0237-6280	Res, Fxd, Comp, 1.3K
A3R14	0238-8770	Res, Fxd, MF, 100, 1/8W
A3R15	0203-6720	Res, Fxd, Comp, 10K, 2W
A3R16	0109-6310	Res, Var, Film, 100
A3R17	0203-6720	Res, Fxd, Comp, 10K, 2W
A3R18	0327-6280	Res, Fxd, Comp, 1.3K
A3R19	0203-6720	Res, Fxd, Comp, 10K, 2W
A3R20	0238-9180	Res, Fxd, MF, 1.47K, 1/8W
A3R21	0203-6720	Res, Fxd, Comp, 10K, 2W
A3R22	0109-6370	Res, Var, Film, 500
A3R23	0235-4850	Res, Fxd, Comp, 10K, ¼W
A3R24	0109-6400	Res, Var, Film, 50K
A3R25	0235-4850	Res, Fxd, Comp, 10K, ¼W
A3R26	0238-8870	Res, Fxd, MF, 2.55K, 1/8W
A3R27,28	0235-4810	Res, Fxd, Comp, 6.8K, ¼W
A3R29	0238-8870	Res, Fxd, MF, 2.55K, 1/8W
A3R30,31	0238-8860	Res, Fxd, MF, 2.37K, 1/8W
A3R32,33	0235-4670	Res, Fxd, Comp, 1.8K, ¼W
A3R34	0238-9290	Res, Fxd, MF, 3.01K, ¼W
A3R35,36	0235-4620	Res, Fxd, Comp, 1K, ¼W
A3R37	0238-9290	Res, Fxd, MF, 3.01K, ¼W
A3R38,39	0203-0600	Res, Fxd, Comp, 3.3K, ½W
A3R40,41	0238-9280	Res, Fxd, MF, 12K, 1/8W
A3R42	0235-4970	Res, Fxd, Comp, 33K, ¼W
A3R43	0235-5050	Res, Fxd, Comp, 68K, ¼W
A3R44	0235-4730	Res, Fxd, Comp, 3.3K, ¼W
A3R45	0235-5050	Res, Fxd, Comp, 68K, ¼W
A3R46	0235-4970	Res, Fxd, Comp, 33K, ¼W
A3R47	0235-5050	Res, Fxd, Comp, 68K, ¼W
A3R48	0238-9420	Res, Fxd, MF, 4.48K 1/4% 1/8W
A3R49	0238-9410	Res, Fxd, MF, 167 1/4% 1/8W
A3R50	0238-9400	Res, Fxd, MF, 18.7 1/4%, 1/8W
A3R51	0235-4780	Res, Fxd, Comp, 5.1K, ¼W
A3R52,53	0235-4310	Res, Fxd, Comp, 51, ¼W
A3R54	0235-4750	Res, Fxd, Comp, 3.9K, ¼W
A3R55	0235-4750	Res, Fxd, Comp, 3.9K, ¼W
A3R56	0235-4140	Res, Fxd, Comp, 10, ¼W
A3R57	0235-4720	Res, Fxd, Comp, 3K, ¼W
A3R58	0235-5160	Res, Fxd, Comp, 200K, ¼W
A3R59	0235-4850	Res, Fxd, Comp, 10K, ¼W
A3R60	0235-4540	Res, Fxd, Comp, 470, ¼W
A3R61	0235-4650	Res, Fxd, Comp, 1.5K, ¼W
A3R62	0235-4620	Res, Fxd, Comp, 1K, ¼W
A3R63	0203-0790	Res, Fxd, Comp, 20K, ½W
A3R64	0235-4490	Res, Fxd, Comp, 300, ¼W
A3R65	0235-4880	Res, Fxd, Comp, 13K, ¼W
A3R66	0235-5130	Res, Fxd, Comp, 150K, ¼W
A3R67	0235-4880	Res, Fxd, Comp, 13K, ¼W
A3R68	0235-4380	Res, Fxd, Comp, 100, ¼W
	4003-1424	Printed Circuit Board
	5102-2760	Pin, Contact
	8100-5890	Heat, Sink
A14R4	0107-3501	Res, Var, Comp, 5K
A14R5,6	0107-3481	Res, Var, Comp, Dual, 10K/10K
A14S2	0503-2780	Switch, P.B.
A14S3	See A14R5,6	Switch, Slide
J1	0906-0120	Connector, BNC


935
934
925
(5)
(8)
2
7
902
901
3
915
93
901
3
968
924
923
957
2
925
7
(0)
(9)
(1)
4003142A-4

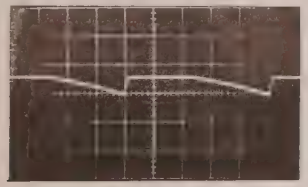
Waveforms (fig. 5-8)

When making the measurements to verify the waveforms below set the front panel controls to the initial settings listed below.

AC-GND-DC (5) (14)	— DC
VERNIER (7) (13)	— CAL
X10 GAIN (7) (13)	— push in
VERTICAL MODE (9)	— ALT
VOLTS/DIV (6) (12)	— .1
TRIG MODE (10)	— COMP
COUPLING (21) (33)	— AC
SLOPE (22) (32)	— +
SOURCE (23) (31)	— EXT/10
SWEEP MODE (25)	— TRIG
HORIZ MODE (29)	— NORM
VERNIER (28)	— CAL
X10 GAIN (37)	— push in
MAIN SWEEP LENGTH (50)	— FULL
TIME/DIV (27A)	— 50 usec/div

Connect a 1 KHZ, 12v p-p sine wave to the TRIG IN (24) connector. Trigger the test scope from this signal also.

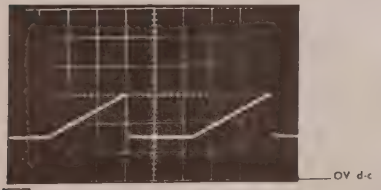
Voltages are measured with no signals connected, LEVEL (19)—centered and SWEEP MODE (25)—SINGLE.



1

VERT: .05 v/div a-c coupled

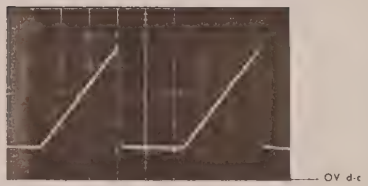
HOR: .2 msec/div



2

VERT: 5 v/div d-c coupled

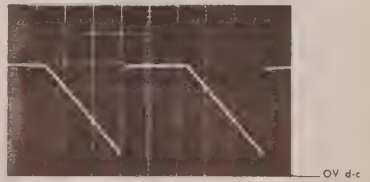
HOR: .2 msec/div



3

VERT: 20 v/div d-c coupled

HOR: .2 msec/div



4

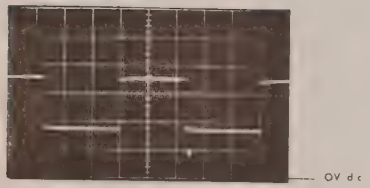
VERT: 20 v/div d-c coupled

HOR: .2 msec/div

5

VERT: .2 v/div d-c coupled

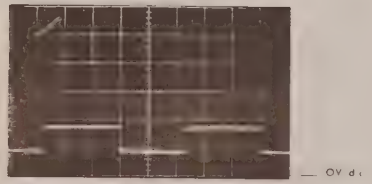
HOR: .2 msec/div



6

VERT: .5 v/div d-c coupled

HOR: .2 msec/div



7

VERT: 10 v/div d-c coupled

HOR: .2 msec/div

NOTE:

.Voltages measured with settings listed above plus:

HOR POS (36) — centered

INTENSITY (39) — nominal brightness

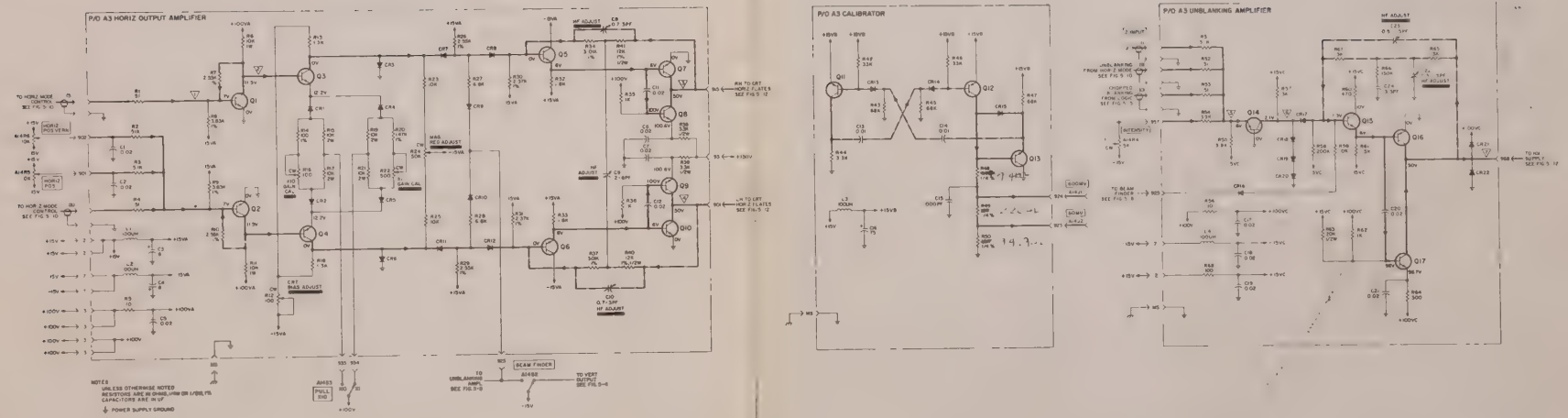


FIG. 5-8
HORIZONTAL OUTPUT AMPLIFIER

5-25/5-26

TABLE 5-9

Reference Designation	Stock Number	Description
A11	8901-7812	Time Switch Assy.
A11C1	0317-5130	Cap, Fxd, Mica, 27 pf
A11C2	0317-5370	Cap, Fxd, Mica, 240 pf
A11C3	0328-1280	Cap, Fxd, Film, 0.0022 µf
A11C4	0328-1290	Cap, Fxd, Film, 0.01 µf
A11C5	0328-1300	Cap, Fxd, Film, 0.22 µf
A11C6	0328-1310	Cap, Fxd, Film, 0.47 µf
A11C7	0328-0770	Cap, Fxd, Elect, 3 µf, 150V
A11C8	0317-5150	Cap, Fxd, Mica, 33 pf
A11C9	0328-1350	Cap, Fxd, Mica, 4000 pf
A11C10	0328-0860	Cap, Fxd, Film, 0.4 µf
A11C13	0317-5150	Cap, Fxd, Mica, 33 pf
A11C14	0328-1350	Cap, Fxd, Mica, 4000 pf
A11C15	0328-0860	Cap, Fxd, Film, 0.4 µf
A11R1,2	0238-9070	Res, Fxd, MF, 180K, 1/8W
A11R3	0238-9080	Res, Fxd, MF, 540K, 1/8W
A11R4	0238-9090	Res, Fxd, MF, 900K, 1/8W
A11R5	0238-9100	Res, Fxd, MF, 1.8M, 1/4W
A11R6	0238-8560	Res, Fxd, MF, 5.4M
A11R7	0238-8570	Res, Fxd, MF, 9M
A11R8	0238-8580	Res, Fxd, MF, 18M
A11R9,10	0107-3461	Res, Var, 2/25K, W/SW
A11R11,12	0238-9070	Res, Fxd, MF, 180K, 1/8W
A11R13	0238-9080	Res, Fxd, MF, 540K, 1/8W
A11R14	0238-9090	Res, Fxd, MF, 900K, 1/8W
A11R15	0238-9100	Res, Fxd, MF, 1.8M, 1/4W
A11R16	0238-8560	Res, Fxd, MF, 5.4M
A11R17	0238-8570	Res, Fxd, MF, 9M
A11R18	0238-8580	Res, Fxd, MF, 18M
A11S1,2	0501-8662	Switch, rotary
A11S3,4		See A11R9,10
C4-7	0328-0850	Cap, Fxd, Film, 1 µf, 1%
A13R19	0235-4720	Res, Fxd, 3K, 1/4W, 5%
A13CR1	2601-0710	Diode, LED

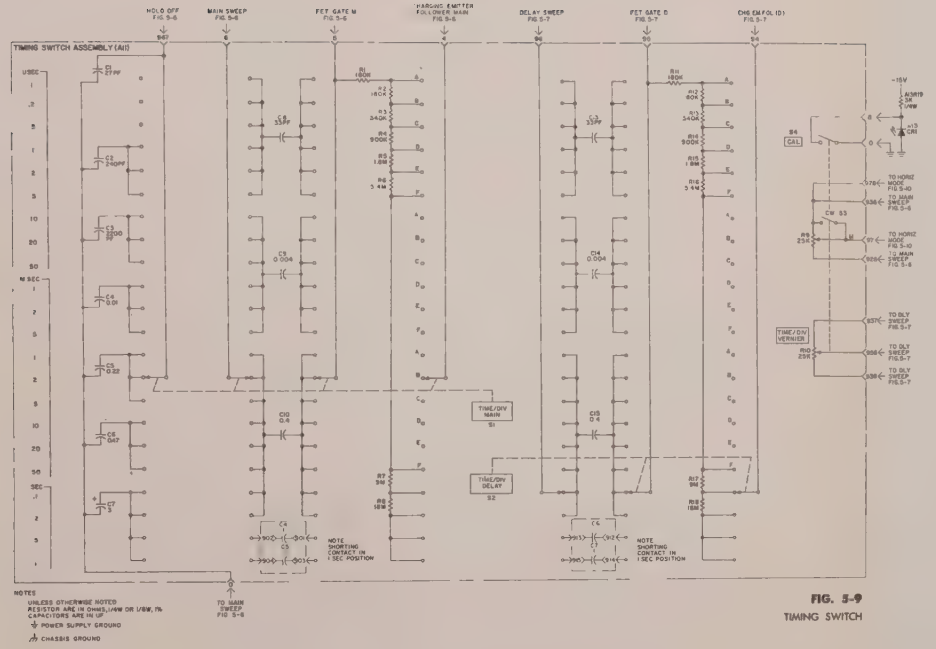

TIMING SWITCH ASSEMBLY (A11)
HOLD OFF FIG 5-6
MAIN SWEEP FIG 5-8
FET GATE M FIG 5-6
HARDING EMITTER FOLLOWER MAIN FIG 5-6
DELAY SWEEP FIG 5-7
FET GATE D FIG 5-7
CHS EMPOL ID FIG 5-7
TIME/DIV MAIN S1
TIME/DIV DELAY S2
TIME/DIV VERNIER
CAL
TO HORIZ MODE FIG 5-10
TO MAIN SWEEP FIG 5-8
TO DLY SWEEP FIG 5-7
NOTE SHORTING CONTACT IN 1 SEC POSITION
NOTES
UNLESS OTHERWISE NOTED RESISTOR ARE IN OHMS, 1/4W OR 1/8W, 1% CAPACITORS ARE IN UF
POWER SUPPLY GROUND
CHASSIS GROUND
TO MAIN SWEEP FIG 5-8

FIG. 5-9
TIMING SWITCH

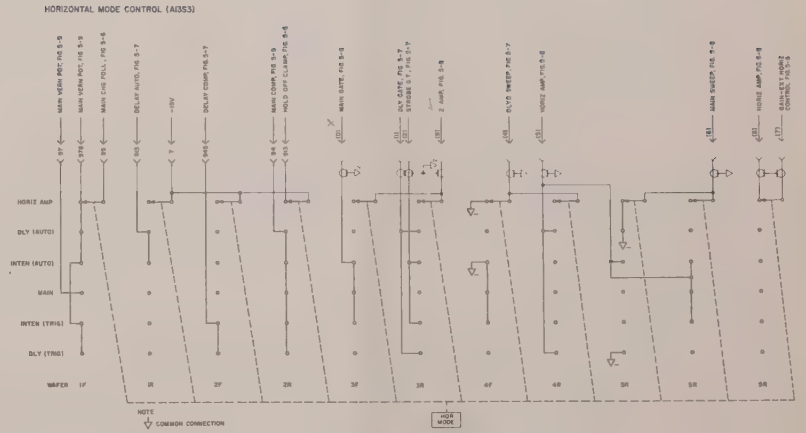


FIG. 5-10
HORIZONTAL MODE

TABLE 5-11

Reference Designation	Stock Number	Description
A5	8901-7817	L.V. Power Supply Regulator Assy.
A5C1	0328-1250	Cap, Fxd, Elect, 6.8 μf, 35v
A5C2	0328-1340	Cap, Fxd, 5600 pf
A5C3	0328-1270	Cap, Fxd, Cer, 20 pf
A5C4	0328-1340	Cap, Fxd, 5600 pf
A5C5	0328-1330	Cap, Fxd, 0.01 μf
A5C6,7	0328-1250	Cap, Fxd, Elect, 6.8 μf, 35v
A5C8	0328-1340	Cap, Fxd, 5600 pf
A5C9	0328-1270	Cap, Fxd, Cer, 20 pf
A5C10	0328-1340	Cap, Fxd, 5600 pf
A5C11	0328-0710	Cap, Fxd, Elect, 75 μf, 25v
A5C12	0328-0820	Cap, Fxd, Elect, 10 μf, 150v
A5C13	0317-5470	Cap, Fxd, Mica, 510 pf
A5C14	0328-1270	Cap, Fxd, Cer, 20 pf
A5C15	0328-1360	Cap, Fxd, Elect, 100 μf, 50v
A5CR1-7	2600-6930	Dio, Si, FD-100
A5CR8	2601-0510	Dio, Zener, 1N4764A
A5CR9	2601-0500	Dio, Zener, 1N936A
A5CR10-19	2601-0570	Dio, Si, 400 PIV
A5IC1-3	2601-0490	Integrated Circuit, MC1709CG
A5Q1,2	2601-0400	Tstr, MM3001
A5Q3	2601-0550	Tstr, 2N3053
A5Q4	2600-9880	Tstr, 2N3646
A5Q5	2601-0160	Tstr, 2N4916
A5Q6	2601-0560	Tstr, 2N4890
A5R1	0109-6330	Res, Var, WW, 500
A5R2	0238-9030	Res, Fxd, MF, 8.45K, 1/8W
A5R3	0238-9010	Res, Fxd, MF, 4.99K, 1/8K
A5R4	0235-4600	Res, Fxd, Comp, 820, ¼W
A5R5	0235-4810	Res, Fxd, Comp, 6.8K, ¼K
A5R6	0235-4650	Res, Fxd, Comp, 1.5K, ¼W
A5R7,8	0235-4680	Res, Fxd, Comp, 2K, ¼W
A5R9	0235-4450	Res, Fxd, Comp, 200, ¼W
A5R10	0203-3480	Res, Fxd, Comp, 1K, 1W
A5R11	0235-1360	Res, Fxd, WW, 3, 2W
A5R12,13	0238-9020	Res, Fxd, MF, 7.15K, 1/8W, 1/2%
A5R14	0235-4810	Res, Fxd, Comp, 6.8K, ¼W
A5R15	0235-4650	Res, Fxd, Comp, 1.5K, ¼W
A5R16,17	0235-4680	Res, Fxd, Comp, 2K, ¼W
A5R18	0235-4450	Res, Fxd, Comp, 200, ¼W
A5R19	0235-1370	Res, Fxd, WW, 2.2, 2W
A5R20	0203-3480	Res, Fxd, Comp, 1K, 1W
A5R21	0235-5470	Res, Fxd, Comp, 3.9M, ¼W
A5R22	0238-9150	Res, Fxd, MF, 47.5K, 1/2W, 1/2%
A5R23,24	0238-9000	Res, Fxd, MF, 3.57K, 1/8W, 1/2%
A5R25	0235-4810	Res, Fxd, Comp, 6.8K, ¼W
A5R26	0235-4650	Res, Fxd, Comp, 1.5K, ¼W
A5R27	0203-3720	Res, Fxd, Comp, 10K, 1W
A5R28	0235-4560	Res, Fxd, Comp, 560, ¼W
A5R29	0238-8540	Res, Fxd, WW, 10, 5W
A5R30	0235-4670	Res, Fxd, Comp, 1.8K, ¼W
A5R31	0235-4380	Res, Fxd, Comp, 100, ¼W
A5R32	0238-8550	Res, Fxd, WW, 7K, 5W
A5R33	0203-0000	Res, Fxd, Comp, 10, ½W
	4003-1495	Printed Circuit Board

Reference Designation	Stock Number	Description
LT1,2	1201-2600	Lamp
Q1	2600-9150	Tstr, Si, 2N3442
Q2	2601-0600	Tstr, Si, 2N3766
Q3	2601-0450	Tstr, Si, 2N4898
S1	0503-2480	Switch, Slide
T1	2101-9591	Transformer

A14LT1	1201-2610	Lamp
A14R2	0107-3511	Res, Var, Comp, 500
A14S1	See A14R2	Switch
C1	0328-1380	Cap, Fxd, Elect, 500 μf, 200 V
C2	0328-1190	Cap, Fxd, Elect, 8400 μf, 40 V
C3	0328-1370	Cap, Fxd, Elect, 4000 μf, 30V
F1	1100-5280	Fuse, 2A, MDL
F2	1100-0740	Fuse, ½A
F3	1100-0710	Fuse, 1/8A

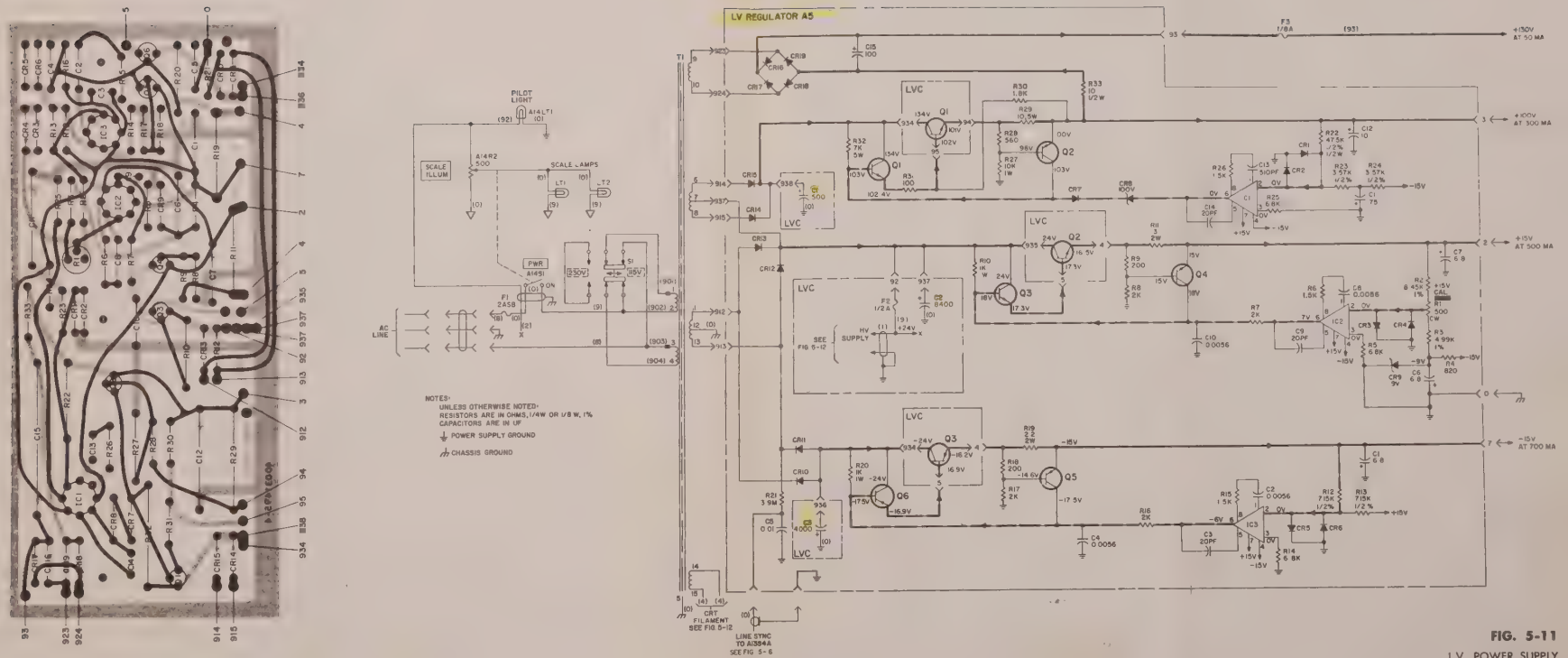
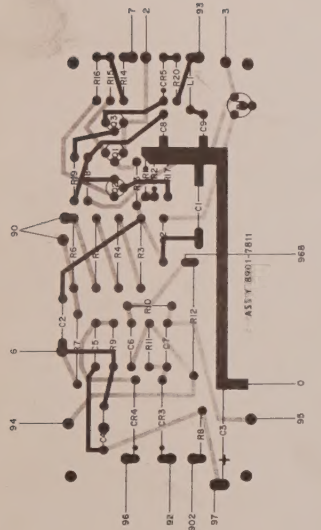


FIG. 5-11
L.V. POWER SUPPLY

5-29/5-30

TABLE 5-12

Reference Designation	Stock Number	Description
A12A6	8901-7811	H.V. Printed Circuit Assembly
A12A6C1	0328-1220	Cap, Fxd, 1 μf
A12A6C2	0316-9190	Cap, Fxd, Cer, 0.001 μf
A12A6C3	0328-0820	Cap, Fxd, Elect, 10 μf, 150V
A12A6C4,5,6,7	0328-1210	Cap, Fxd, Cer, 0.023 μf
A12A6C8	0317-5470	Cap, Fxd, Mica, 510 pf
A12A6C9	0328-1390	Cap, Fxd, Mylar 0.022 μf
A12A6CR1,2	2600-6930	Dio, Si, FD-100
A12A6CR3,4	2601-0540	Dio, Si, H.V., 8kV
A12A6CR5	2600-9360	Dio, Zener, 1N752A
A12A6L1	2110-2530	Ind, Fxd, 1 mH
A12A6Q1,2,3	2600-9860	Tstr, Si, 2N3565
A12A6R1	0109-6410	Res, Var, Film, 100k
A12A6R2	0238-8940	Res, Fxd, MF, 500k, 1/8W
A12A6R3,4,5	0238-9130	Res, Fxd, MF, 1.33M, 1/2W
A12A6R6	0238-9580	Res, Fxd, MF, 619k, 1/2W
A12A6R7	0238-9590	Res, Fxd, MF, 2.0M, 1/2W
A12A6R8	0235-4620	Res, Fxd, Comp, 1k, 1/4W
A12A6R9	0235-4920	Res, Fxd, Comp, 20k, 1/4W
A12A6R10	0235-4920	Res, Fxd, Comp, 20k, 1/4W
A12A6R11	0235-5160	Res, Fxd, Comp, 200k, 1/4W
A12A6R12	0228-0050	Res, Fxd, H.V., 35M
A12A6R13	0235-4850	Res, Fxd, Comp, 10k, 1/4W
A12A6R14	0235-4890	Res, Fxd, Comp, 15k, 1/4W
A12A6R15,16	0235-4460	Res, Fxd, Comp, 220, 1/4W
A12A6R17	0235-4810	Res, Fxd, Comp, 6.8k, 1/4W
A12A6R18	0235-5160	Res, Fxd, Comp, 200k, 1/4W
A12A6R19	0235-4620	Res, Fxd, Comp, 1k, 1/4W
A12A6R20	0235-4730	Res, Fxd, Comp, 3.3k, 1/4W
	4003-1385	Printed Circuit Board
A8R41	0235-4140	Res, Fxd, Comp, 10, 1/4W
A8R42	0235-4910	Res, Fxd, Comp, 18k, 1/4W
A8R43	0235-4920	Res, Fxd, Comp, 20k, 1/4W
A12C1	0328-0710	Cap, Fxd, Elect, 75 μf, 25V
A12CR1	2601-0570	Dio, Si, 400 PIV
A12M1	8800-3262	H.V. Tripler
A12Q1	2601-0600	Tstr, Si, 2N3766
A12R1	0235-4820	Res, Fxd, Comp, 7.5k, 1/4W
A12T1	2001-4943	Transformer
A12L1	2101-9010	Ind, Mld, 2.5 mH
A14R1	0107-3521	Res, Var, Comp, 5M
R1	0107-3910	Res, Var, Comp, 50k
R2	0109-1770	Res, Var, WW, 4k
R3	0235-5330	Res, Fxd, Comp, 1M, 1/4W
R4	0107-3910	Res, Var, Comp, 50k
R5	0109-4560	Res, Var, Comp, 50k
CRT-1	2501-9001	Cathode Ray Tube

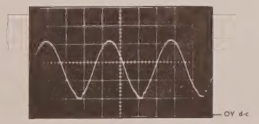


Waveforms (fig. 5-12)

When making the measurements to verify the waveforms below set the front panel controls to the initial settings listed below.

AC-GND-DC (5) (14)	— DC
VERNIER (7) (13)	— CAL
X10 GAIN (7) (13)	— push in
VERTICAL MODE (9)	— ALT
VOLTS/DIV (6) (12)	— .1
TRIG MODE (10)	— COMP
COUPLING (21) (33)	— AC
SLOPE (22) (32)	— +
SOURCE (23) (31)	— INT
SWEEP MODE (25)	— SINGLE
HORIZ MODE (29)	— NORM
VERNIER (28)	— CAL
X10 GAIN (37)	— push in
MAIN SWEEP LENGTH (50)	— FULL

Trigger the test scope internally.



VERT: 10 v/div d-c coupled

HOR: 10 usec/div

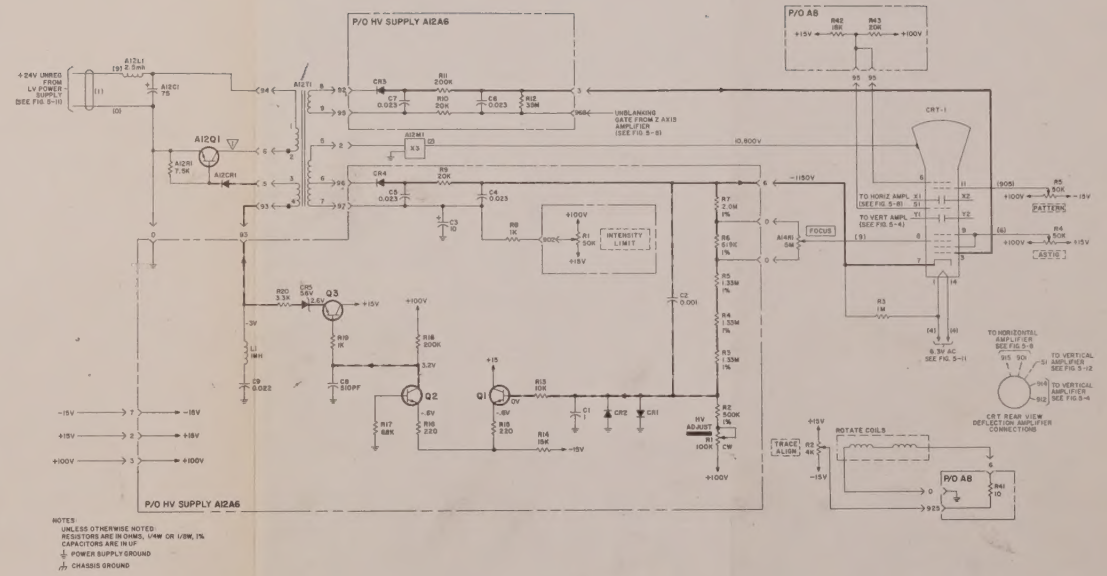


FIG. 5-12
H.V. POWER SUPPLY

DUMONT
OSCILLOSCOPE